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THEME

Trial to valorize brine from a demineralization station

Diagnosis of Some plants in the El- Oued region

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الحمد لله الذي ما تيقنت به املا الا واغرقني سرورا و فرحا ،

أهدي حلمي الذي لطالما انتظرته طويلا الى الذي زين أسمي بأجمل الالقاب من دعمني بلا حدود ،أعطاني بلا مقابل إلى من علمني أن الدنيا كفاح وسلاحها العلم و المعرفة ، الى من غرس في روحي مكارم الاخلاق داعمي الاول في مسيرتي و قوتي وملاذي بعد الله إلى فخري واعتزازي "أبي الغالي .

إلى من جعل الله الجنة تحت أقدامها واحتضنتني بقلبها قبل يديها وسهلت لي الشدائد بدعائها إلى القلب الحنون الشمعة التي كانت لي في الليالي المظلمات، سر قوتي ونجاحي مصباح دربي إلى بهج حياتي امي العزيزة .

إلى "اخوتي" ملهمي نجاحي إلى من شددت عضدي بهم فكانوا لي ينابيع ارتواء الى خيرة ايامي وصفوتها .

الى عائلتي الصغيرة زوجتي ورفيقة دربي وإلى بنتيا الصغيرتين

الى رفقاء الخطوة الاولى ومن جمعتني بيهم اساور الجامعة واللحظات الجميلة ولكل باسمه .

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وادة رابعة

Abstract

This study aimed to understand the impact of saline water on soil and plants and the importance of using appropriate irrigation techniques to mitigate the effects of salinity. It also highlights the need to develop sustainable strategies to improve agricultural productivity in salinity-affected environments. Our study seeks to utilize saline water from desalination plants to support areas suffering from traditional water shortages, using it as an alternative to reduce the demand for conventional water. The analysis results showed that saline water negatively affects beet productivity, but when diluted, effective production can be achieved. As salinity levels increase, production decreases; however, using drip irrigation mitigates the negative impact on production.

Keywords: Desalination plants, saline water, saline soil , irrigation, drip irrigation.

Résumé:

Cette étude visait à comprendre l'impact de l'eau salée sur le sol et les plantes ainsi que l'importance d'utiliser des techniques d'irrigation appropriées pour atténuer les effets de la salinité. Elle met également en évidence la nécessité de développer des stratégies durables pour améliorer la productivité agricole dans les environnements affectés par la salinité. Notre étude cherche à utiliser l'eau salée des usines de dessalement pour soutenir les régions souffrant de pénuries d'eau traditionnelle, en l'utilisant comme une alternative pour réduire la demande en eau conventionnelle. Les résultats des analyses ont montré que l'eau salée a un effet négatif sur la productivité de la betterave, mais lorsqu'elle est diluée, une production efficace peut être atteinte. À mesure que le niveau de salinité augmente, la production diminue ; cependant, l'utilisation de l'irrigation goutte-à-goutte atténue l'impact négatif sur la production.

Les Mots clés: Usines de dessalement, eau salée, sol salin , irrigation, irrigation goutte à goutte.

المخلص :

استهدفت هذه الدراسة فهم تأثير المياه المالحة على التربة والنباتات وأهمية استخدام تقنيات الري المناسبة للتخفيف من آثار الملوحة. كما تبرز الحاجة إلى تطوير استراتيجيات مستدامة لتحسين إنتاجية الزراعة في البيئات المتأثرة بالملوحة. تهدف دراستنا إلى استغلال المياه المالحة الناتجة عن محطات التحلية لدعم المناطق التي تعاني من نقص المياه التقليدية، واستخدامها كبديل لتخفيف الضغط على طلب المياه التقليدية .أظهرت نتائج التحاليل التي

أجريت على المياه أن ملوحة المياه لها تأثير سلبي على إنتاجية نبتة الشمندر، ولكن عند تخفيفها يمكن تحقيق إنتاج فعال. كلما ارتفعت ملوحة المياه انخفض الإنتاج، ولكن استخدام الري بالتنقيط يخفف من الأثر السلبي على الإنتاج.

كلمات المفتاحية : محطات التحلية، مياه المالحة، التربة المالحة ، الري ، الري بالتنقيط .

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General Introduction

General Introduction

Traditional water resources in Algeria are insufficient to ensure water security, which is considered a future challenge. With the increasing demand for water due to changing consumption patterns **(Djebbari.2023).** the country has resorted to unconventional methods to obtain fresh water through desalination technology, which has become the optimal solution for bridging the water gap**(Amrouci .2020)**. The desalination process involves the removal of salts and minerals from seawater and groundwater using various techniques such as reverse osmosis, distillation, and electrolysis.

Given that Algeria has water resources consisting of 9.8 billion cubic meters of surface water and 7.1 billion cubic meters of groundwater**(kadouda,2018)**, the optimal exploitation of these water resources has been achieved by harnessing 23 desalination plants with a capacity of 5700 cubic meters, distributed along the 1200-kilometer-long coastline. In a second phase, 13 large plants were established with a total capacity of 1,940,000 cubic meters **(Bousmaha.2020)**. Between 2003 and 2005, additional plants were commissioned during the period 2009-2011, including the following: Skikda (100,000 m^3/day), Beni Saf (200,000 m^3/day), Souk Tleta (Tlemcen) (200,000 m^3/day), Hennaya Tlemcen (200,000 m^3/day), Mostaganem (200,000 m^3/day), Fouka (Tipaza) (120,000 m^3/day), Oued Sebt (Tipaza) (100,000 m^3/day), Cap Djenet (Boumerdes) (100,000 m^3/day), Chlef (200,000 m^3/day), El Tarf (50,000 m^3/day), and the Magtaa plant (Oran), which is the largest in Algeria with a production capacity of 500,000 m^3/day. According to experts, the production of desalinated water is expected to reach 2,580,000 m^3/day by 2020. General Statistics (2012). **(Amitouchea et al ,2017)**.

The massive amounts of desalinated water produced by Algeria reflect the significant environmental impact of this industry. Desalination plants dispose of brine by discharging it into the sea or onto the land. To mitigate potential impacts, Zero Liquid Discharge (ZLD) systems have been implemented, converting all feedwater into drinking water or evaporating the residual water from the process. This approach allows for the provision of desalinated water without discharging brine and affecting the environment**(Amitouchea , Boualem .2014)**.

Soil Degradation and Infrastructure Deterioration due to the Uncontrolled Disposal of Saline Water from Desalination Plants. Hence, we conducted this study divided into the following axes:

- ✓ The first chapter is dedicated to the bibliographic research, which is dedicated to the bibliographic research and is dedicated to the different methods that are used for water desalination and the most important objectives.
- ✓ The second chapter describes irrigation with salt water and its effect on plants, soil, and the reuse of saline solution.
- ✓ Chapter Three: dedicated to discussing practical application, materials used, test results on samples, and discussing the findings.

Finally, we will conclude our work with a general conclusion, and some recommendations.

Bibliographic Section

Chapter 1: Water Desalination: Objectives and Processes

I.1. Introduction

The problem of drought, limited rainfall, and water scarcity prompted Algeria to address this issue and find solutions. Among the solutions Algeria has found is water desalination, whether from groundwater, seawater, or treated sewage water. These solutions have become a means to ensure water supply for all sectors. However, water desalination can have some negative environmental impacts, and precautions must be taken to avoid them. Desalination can affect air emissions and the chemical and physical waste that ends up in the sea, in addition to the impact of desalination plants on the surrounding environment. Desalinated water is distributed between the residential and agricultural sectors **(Bmroucih ,2020)**. Desalination contributes to converting saline water into good-quality water free from pollutants, although it is the most suitable solution, it is economically costly **(Bouadam and Yennoune,2016)** Algeria is one of the largest producers of desalinated water, ranking fifth internationally in production with about 2.6 million cubic meters per day. Algeria relies on reverse osmosis technology in most desalination plants, except for multi-stage flash distillation technology **(Yennoune , 2016).**

I.2. Why desalinate water?

The concept of desalination involves converting saline water into pure, salt-free water suitable for various uses. There are various methods for desalinating water, but differences exist in t`erms of economics, location of the plant, and the quality of water to be desalinate ‹**(Bouadam and Yennoune,2016)** .The importance of desalinated water lies in its role as a crucial resource for providing potable water and supporting industries that require water. Additionally, desalinated water can be used for irrigation purposes, aiming to enhance food security. It serves as a guarantee for the sustainability of freshwater sources, mitigating water scarcity. Various water sources, such as groundwater and seawater, can be desalinated to meet these needs **(Hadjadj and Achenikhar,2022).**

I.2.1 Seawater and Groundwater quality

Desalination of seawater has been known since ancient times. Algeria's first attempt at seawater desalination was in 1980, with the inauguration of a plant using the reverse osmosis method, with a capacity of approximately 57,600 m^3. At the time, it was classified as one of the most important units globally. With the increasing demand for water in northern cities, desalination of seawater has become necessary **(Djebbari ,2023)**. Algeria aims to establish the production capacity of the total seawater desalination plants, which number 25, is 821 million cubic meters annually **(Hamdaoui, 2023)**. Water quality in seawater is determined by measuring factors such as temperature, electrical conductivity, dissolved salts, ions, as well as some chemical indicators like turbidity and pH levels. The quality of seawater varies by region, with some areas having high salinity levels reaching up to 50 (g/l), high mineral content, and varying levels of pollutants and impurities**(Didouh,2017**). Groundwater is also vital as a water source, serving drinking, agricultural, and industrial needs. Much of the north relies on desalinated seawater, while desert regions depend on groundwater as their primary source, despite its poor quality in terms of salinity, temperature, and contamination **(Saggaï et al,2019)**. Groundwater quality is assessed based on physical properties like color, taste, and odor, as well as measurements of pH and electrical conductivity, and analysis of chemical properties such as iron, copper, and lead. Human activities primarily contribute to changes in groundwater quality, with a noticeable decrease in dissolved oxygen levels due to anthropogenic factors**.(Ghrib and Bouguennour , 2021).**

I.2.2. Water needs and water scarcity

The increasing demand for water has led to significant problems globally. Factors contributing to this issue include rapid population growth, particularly in urban areas, where the population has doubled over the past few years, emphasizing the importance of spreading awareness about rational water consumption**(Saead and Hana ,2021)** . Additionally, industrial sector development and a tenfold increase in manufacturing have exacerbated water pollution problems, especially in densely populated areas, which is also considered a major factor in reducing available water. Disposal of factory waste or chemicals into the soil leads to groundwater pollution, making it unusable without desalination and treatment processes. Furthermore, the phenomenon of global warming has worsened water scarcity issues due to temperature increases, resulting in instances of droughts and floods caused by polar ice melting. Irrational water use and poor management, coupled with increasing pressure on water demand, restrict water usage to about 70% in the agricultural sector**(Habeeb,2021).** These impacts create famines and diseases due to low rainfall and continuous drought, affecting agriculture and human and animal health. Areas suffering from water scarcity experience setbacks in all areas. If polluted water is consumed, it causes diseases and problems in the sewage sector. Water scarcity contributes to the loss of life of organisms due to pollution or increased salinity. To address water scarcity, efforts are being made to find solutions for its conservation and utilization from all traditional and non-traditional water sources. With technological advancements, methods for preserving, treating, and distributing water can be further developed and implemented effectively Always by the same author **(Habeeb,2021)**.

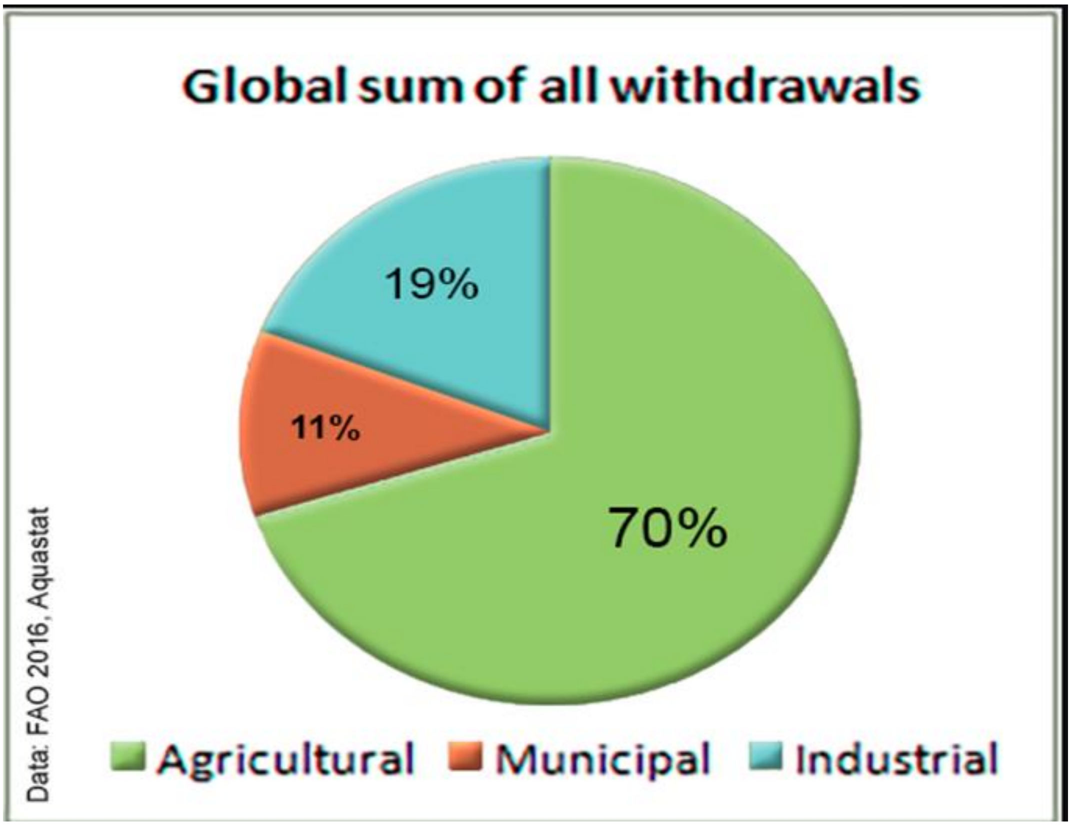


Figure1: water usage around the world. (sources :areq.net)

I.3. Desalination Processes

Desalination processes, with advancements in technology, have become competitive in terms of production, economic growth, and even environmental impact, affecting all aspects. Energy consumption and fuel used in desalination plants are among the major factors in production costs**(Hamdi,2022)** . To meet demands, desalination processes involve a series of significant operations to separate salts and minerals from saline water, whether from seawater or groundwater. The desalination process relies on salt removal, with salinity levels decreasing as temperature and pressure increase**(Achenikhar,2022)**. The director of the International Water Organization emphasized that reducing energy consumption during desalination processes in recent years has led to technological improvements, expected to be more productive with lower energy consumption, better quality, and lower costs in the coming years. The discharged salts are reused for other purposes. The desalination process goes through several stages, including primary treatment of saline water, where salts and minerals are removed based on temperature, salt Concentration of salts and medical factors. **(Amrouci ,2020)** There are two techniques: ion exchange and electrodialysis. As for water production, it results from reverse osmosis or thermal technology.

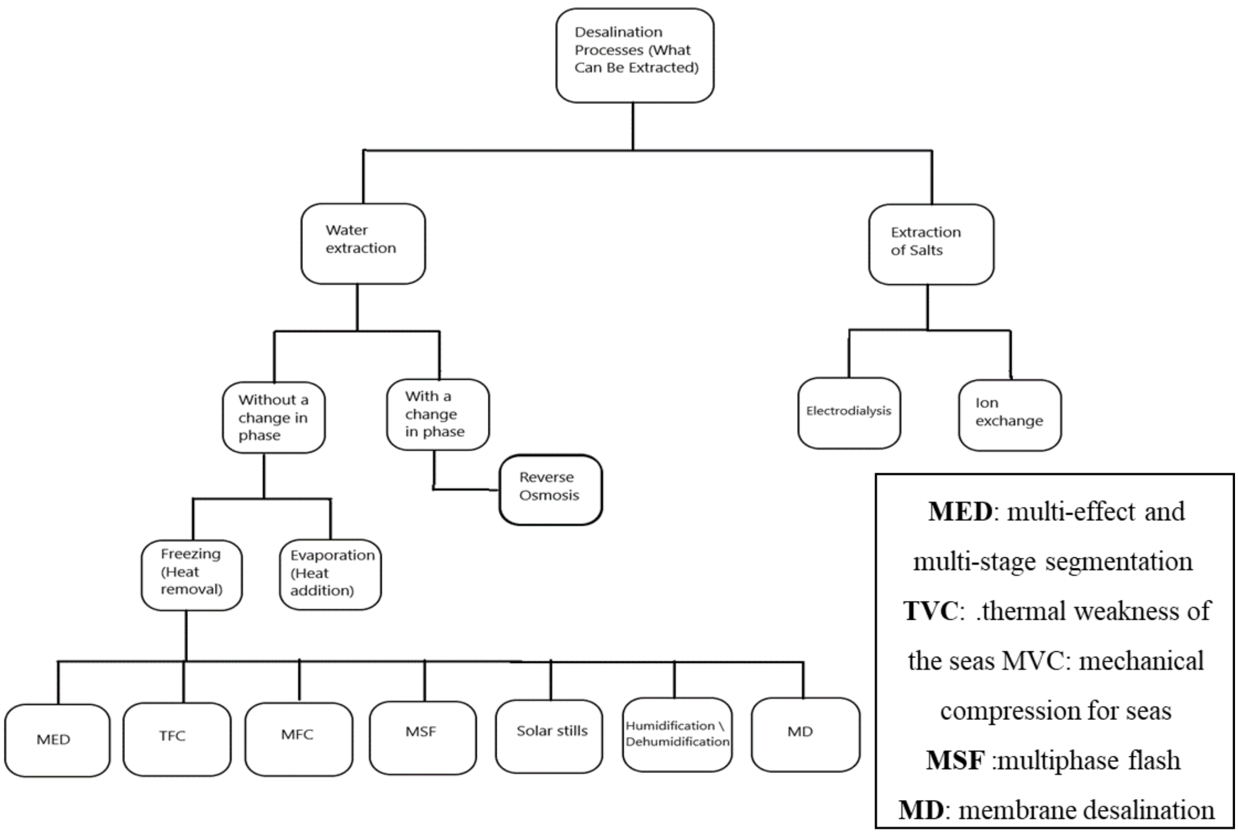


Figure 2: Classification of desalination techniques based on the adopted separate ion method (Cebulena et al 2011) .

I.3.1 Thermal processes (Ahmed ,2014)

❖ **Distillation methods:**

a. Regular distillation

Where saline water is boiled in a tank without pressure. The steam rises to the outlet at the top of the tank, and the resulting water droplets from the rising steam condense and collect in the distilled water tank. This method is used in small-scale production stations.

b. Multi-stage flash distillation

There is an inverse relationship between the boiling point and the pressure applied to it. If the boiling point decreases, the pressure applied to it decreases as well. After heating seawater, it moves to the next stage, where it undergoes low-pressure compression to transform seawater into steam, which is then condensed on a cold surface and collected. It is then treated and made suitable for drinking. This method is used in large-scale production stations.

c. Multi-stage distillation:

The operation of multiple-effect distillers allows for the utilization of the vapor generated from the first condenser to the second condenser. The second evaporator, in turn, can condense the vapor coming from the first evaporator, and the third evaporator functions as the previous evaporators. This is the reason behind its name.

d. Compression Vapor Distillation

Unlike multiple-effect distillation and flash evaporation, which utilize an external steam source for primary heating, compression vapor distillation employs its own steam source after compressing it. This method is energy-efficient as it utilizes the steam's own pressure for heating, making it economical. It is essential to have an additional energy source to benefit from it. Initially, water is heated in a tubular heat exchanger where saline water, reject water, and fresh water discharged from the unit are utilized. Then, seawater enters the distillation tubes and steam is compressed. Subsequently, it returns to the distiller where non-condensable gases are expelled. The compressor serves as a central component of the distillation unit. If the steam is not compressed, it cannot condense on the tubes carrying the boiling water due to the difference in boiling temperature at this pressure.

e. Direct and Indirect Freezing:

The desalination process, also known as freezing, has undergone numerous changes by Colt Industries. The process begins by introducing pre-cooled seawater into the crystallizer or freezing tower. The pressure inside the tower ranges from 3 to 4 mm of mercury, causing sudden evaporation of a portion of seawater. The required heat is drawn to evaporate the remaining seawater, which causes a significantly low freezing point for pure seawater and seawater with low and normal concentrations, reaching temperatures of 3.7(C°) accord to **(Ahmed ,2014)**.

Modern freezers crystallize at an average rate of about 1.5 tons of ice per hour per cubic meter of crystallizer volume. Removing salts through freezing requires about 70 calories to produce one gram of ice, while evaporation requires about 600 calories to produce one kilogram of steam to remove salts. To produce one (Km) of steam 7.5 (Km) accord to **(Ahmed ,2014)** of ice are used. The ice washing method involves passing a counter-current of a small volume, high-quality washing water, submerged completely in liquid, and flowing concentrated brine water through a heat exchanger to cool the seawater essentially.

I.3.2 Membrane processes

Reverse Osmosis (RO): In reverse osmosis, solvent moves through a semi-permeab le membrane to a solution **(B. R.O, 2024)**, crossing it due to a natural and prevalent phenomenon called osmosis. Comparing reverse osmosis to distillation and electrodialysis, it is a newer process dating back to the 1970s. It involves the transfer of fresh water from a low-concentration salt solution to a salt solution through semi-permeable membranes, resulting in a pressure differential known as osmotic pressure. When the pressure exerted on the salt solution exceeds the osmotic pressure, fresh water begins to flow, alongside the opposite movement of saltwater through the membrane. This process does not require heat or changes in shape, constituting a system consisting of primary treatment, high-pressure pump, membrane array, and final treatment. Primary treatment is crucial, with feed water passing through narrow passages during the process. Additionally, obstacles such as membrane fouling must be addressed, often requiring chemical treatment and the addition of chemicals to prevent scaling. A high-pressure pump is used to force water through the membranes and trap salts, with pressure typically ranging from 17 to 27 bar. The membrane assembly includes a pressure vessel and a membrane capable of withstanding pressure differentials. Semi-permeable membranes are prone to breakage and vary in their ability to allow fresh water passage while retaining salts. No membrane completely seals off salts, resulting in some salt content in the produced water. Reverse osmosis membranes come in various configurations, with two commercially successful types being spiral wound and hollow fiber. These types find applications in desalinating well water and seawater despite differences in membrane construction and pressure vessels. As for final treatment, its purpose is to maintain water characteristics and prepare it for distribution, which may include gas removal and alkalinity adjustment. Advancements in membrane technology and the use of energy recovery processes have helped reduce operational costs. Energy recovery devices are typically connected to the concentrate stream upon exiting the pressure vessel, often operating on mechanical energy in the form of pumps. Always by the same author **(Ahmed ,2014)**

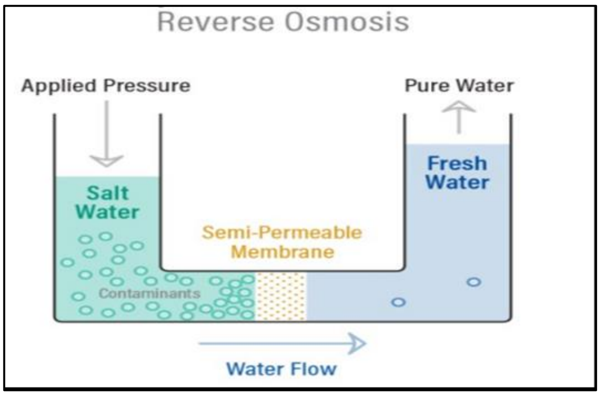


Figure 3: Reverse Osmosis (sources: Basics of Reverse Osmosis)

I.2.Electrodialysis Desalination (ED):

Always by the same author **(Ahmed ,2014)** Electrodialysis, also known as electrodialysis desalination, predates reverse osmosis by ten years. It is effective for desalinating brackish well waters. This technology is defined as the transfer of ions from one membrane to another under an electrical voltage. The electrodialysis desalination device consists of alternating arrays of positive and negative electrodes through which ions are exchanged under an electric current. The membranes separate these electrodes to form chambers through which the solution passes, creating membranes that allow purified ions to pass through.

Ions can be either positively or negatively charged, and during the electrodialysis process, ions carrying an opposite charge are attracted. This technology relies on three fundamentals:

1. Soluble salts carrying ions uniformly either positively or negatively charged.
2. The electric field attracting ions towards the opposite charge.
3. The creation of membranes to allow ion passage.

In electrodialysis desalination, ions carrying the opposite charge are attracted and removed through the membranes, resulting in desalinated water.

The ions remain dispersed in water to balance their charges. They migrate towards opposite charges when electrodes are connected to an electric current. This phenomenon is utilized for desalinating saline water. The ions of a single type pass through the membranes, not two types, and are placed sequentially. A membrane passes between them, directing ions towards the positive pole. As a result, salts concentrate in the resulting water. When negative charge passes, it cannot cross the membrane designed for positive charges, leaving negative ions in the saline water. Positive ions move towards the opposite direction through the positive ion-selective membrane. This creates high and low concentration solutions between alternating membranes, and the space between membranes is called the cell. One side of the cell is diluted with the produced water, and the other is concentrated with the return water.

The electrodialysis unit consists of primary treatment, membrane assembly, low-pressure circulation pump, power supply, and final treatment. Treating feedwater is necessary to prevent clogging. Feedwater is circulated through the assembly using a low-pressure pump, and an oscillator converts alternating current to direct current. Final treatment focuses on water treatment and preparation for distribution.

I.3.3 Pros and Cons of processes (Domenico et al ,2021)

a) Positives or advantages of water desalination processes:

Reducing water salinity and mineral concentration.

Removing microbes and viruses.

Increasing water supply.

In agriculture: crop irrigation.

Decreasing demand for groundwater through seawater desalination.

Eliminating organic materials.

Removing organic pollutants.

Producing large quantities of fresh water.

An effective solution for addressing water scarcity.

Increasing consumer energy efficiency by reducing natural gas boiling.

Reverse osmosis technology consumes between 3 to 5 kilowatt-hours per cubic meter. **(Jariri, 2009)**.

b) Negatives or disadvantages of water desalination processes:

Economically, they are highly expensive.

Increase in temperature and salinity of brine, leading to environmental disruption.

Emissions of gases contributing to global warming.

Some plants produce water with high salinity, requiring additional treatment.

Significant electricity consumption is required.

Plants are subject to corrosion over time.

Maintenance costs are high due to membrane replacement expenses, which do not exceed 7 years at present. **(Jariri, 2009)**.

I.4. The fate of the brine water (2022, khaled shehab):

The brine solution is highly saline water that has harmful effects on the environment. Desalination plants produce brine solution containing minerals, nitrates, nitrogen, phosphorus, and organic pollutants. There are various methods for disposing of brine solution:

1. Discharge into surface water bodies or sewage systems: Disposing of brine in a water body or sewer is a cost-effective solution. However, disposal methods vary from region to region based on specific conditions such as concentrations of concerning components, daily mass totals, and temperature. Low-cost solutions include using green sand to remove iron. Nevertheless, disposing of brine solution in surface water bodies or sewers is the most effective solution.

2. Injection into deep wells: Brine solution can also be disposed of by injecting it into deep wells, provided they are far from groundwater layers that feed drinking water sources.

3. Evaporation ponds: This is an artificial solution for draining internal surface water from brine solution. With the rise in temperature, water evaporates, leaving behind solid matter, which can be disposed of or recycled. Multiple evaporation ponds are necessary to alternate between evaporating brine solution and extracting solid matter.

4. Incineration of brine solution: Brine solution is sent to incinerators where it mixes with solid waste. During incineration, the mixed solution solidifies, requiring treatment.

Disposing of brine solution in open water bodies or other unsustainable methods has raised structural and regulatory concerns, leading to increased demand for brine solution management.

I.5. Conclusion

The objectives of this chapter were to investigate water desalination processes, define water desalination processes, provide background information, elucidate the processes involved in water desalination, and discuss the positives and negatives of each industry. We also addressed how to dispose of brine solution. It is essential to treat water for use to meet the needs. In the second chapter, we will define saline water and its importance in agriculture.

Chapter II: irrigation with salty water

II.1.Introduction

Water with a high concentration of salts, known as saline irrigation water, is a significant factor that affects soil fertility. This water can render the soil unsuitable for cultivation due to continuous salt accumulation which is the result of salty water evaporation . Consequently, it may be difficult to grow crops in such lands due to the severity of salinity in irrigation water **(Jwaihi et al ,2014).**

The impact of the salinity level of irrigation water can also affect the the water of irrigation methods. A high concentration of salts may require adjustments in irrigation methods, which help reduce evaporation rates and decrease salt concentration in the soil.

Overall, the concentration of salts in irrigation water is considered one of the most important determinants for growth and production in agriculture. Salinity levels affect the ability of plants to absorb water and nutrients, thereby significantly influencing yield and crop quality **(Al-Rubaie,2022)**.

II.2.Effects of salty water on soil structure:

The effect of high salinity concentration in water can lead to soil destruction, as groundwater or seawater often contain high levels of salt. The salinity of water is due to the salt content in the soil, especially Sodium and chloride, calcium and magnesium, sulfates, carbonates, bicarbonates **(melissa and rachel ,2024)** .Chloride causes leaf burn in many fruit trees when its concentration exceeds 0.5% in the leaves, and sodium exceeds 0.2%. Boron is also considered among the of water in the soil to most agricultural crops, becoming toxic when its concentration in the soil exceeds 0.5 parts per million**(uoanbar ,2024)**. Changes in climate and rising temperatures cause the evaporation, leading to salt accumulation **(Al-mazirah et al ,2022).** The total concentration of dissolved salts or electrical conductivity, which reflects salinity or salinity level, is measured in microsiemens per centimeter (µS/cm) or micromhos per centimeter (µmho/cm). To estimate soil salinity, electrical conductivity is measured, which varies depending on the type of water and soil **(Mwakil, 2013).** The higher the temperature, the higher the electrical conductivity.**(Tohme and Al -Shehabi ,2011).**

Although there is a positive effect of salts in supporting plant growth and improving soil properties, increased concentration of salt can lead to negative effects. These effects include. **(Modernagritec , 2024)**.

reducing biodiversity due to high salinity levels, where the number of plants decreases and the number of dead plants increases due to inadequate water absorption. Where the yield decreases by up to 50% or less, depending on the salt content. **(Zaiz,2024)**.

Soil erosion refers the land can become eroded due to the decrease in essential elements and the increase in salinity levels, which can be observed through changes on the surface of the land **(Almardia,2022)**.

Figure 4: the appearance of a layer of salts on the soil surface. (Abaar group,2023).

Increase in water level an increase in water levels leads to deterioration of soil condition, causing a decrease in water absorption capacity and resulting in surface runoff **(Bitar,2021) .**

If soil salinity is increased in arid regions with high temperatures and low soil is controlled, farmers may be able to reuse the soil for crop cultivation **(Modernagritec,2024) .**

II.3.Are there plants that can be irrigated with salty water ?

Yes, there are many plants that can be irrigated with saline water as they grow in saline soil, and they can also grow naturally. Many researchers have conducted experiments on salt-tolerant plants, known as halophytes, which can be used for nutrition or fodder **(Charlotte et al,2024)**. Some plants have specialized cells in their leaves called "salt glands" for storing excess sodium chloride. Plants tolerate water salinity because they have the ability to grow with their roots and achieve high and rapid maturity **(al-Ababsa,2023) .**

There are various levels of salinity:

high salinity levels, such as those found in seawater ranging from 10000 to 35000 parts per million in soil irrigated with it, as these plants primarily grow in arid lands near water bodies. Moderate salinity levels range from 3000 to 10000 parts per million in irrigation water, suitable for plants that can thrive in such conditions. Low salinity levels, which are home to many non-halophytic plants range from 1,000 to 3,000 parts per million in irrigation water. Many types of plants can tolerate soil salinity, including trees, shrubs, herbs, flowers, vegetables, and fruits**.(Abdelhabeib ,2024)**

Each plant has its own specific water requirements and growth stages. Many experiments have confirmed that both excessive and insufficient watering can affect plant growth. The presence of salinity on crops and their production varies depending on the irrigation method. **(bensaid et al,2022)**

There are three irrigation methods: traditional irrigation, which is a very old method involving the creation of channels for water flow and often results in water waste, the second method is modern and resembles rainfall delivered in the form of mist, which is superior to traditional irrigation ,One of the most popular irrigation techniques for potato cultivation is the sprinkler and the center pivot irrigation . As for drip irrigation, it is the most commonly used method as it is water-efficient and delivers water sequentially to plants in the form of droplets.

in the table, we mentioned some green crops, fruit crops, and field crops according to the degree of salinity **(Motaz ,2022)**.

Table 1: representing the production rate of crops irrigated saline water and under saline soil .(elyazied,2018)

Average production rate for agricultural crops										
Vegetable crops	100%		90%		75%		50%		0%	
	EC_S	EC_W	EC_S	EC_W	EC_S	EC_W	EC_S	EC_W	EC_S	EC_W
Spinach	2.0	1.3	3.3	2.2	4.4	2.9	6.3	4.2	10.0	6.8
Tomatoes	2.5	1.7	2.5	2.3	5.0	3.4	7.6	5.0	13.0	8.4
Potatoes	1.5	1.0	2.4	1.6	3.8	2.5	6.0	4.0	11.0	7.1
Peppers	1.5	1.0	2.2	1.5	3.3	2.2	5.1	3.4	8.6	5.8
Broccoli	2.8	1.9	3.9	2.6	5.5	3.7	8.2	5.5	14.0	9.1
Lettuce	1.3	0.9	2.1	1.4	3.2	2.1	5.1	3.4	9.0	6.0
Turnip	0.9	0.6	2.0	1.3	3.7	2.5	6.5	4.3	12.0	8.0
Red beet	4.0	2.7	5.1	3.4	6.8	4.5	9.6	6.4	15.0	10.0
Celery	1.8	1.2	3.4	2.3	5,8	3.9	9.9	6.6	18.0	12.0
Carrots	1.0	0.7	1.7	1.1	2.8	1.9	4.6	3.0	8.1	4.5
Sweet potatoes	1.7	1.1	2.5	1.7	3.8	2.5	5.9	3.9	10.0	6.7
Fruit crops										
Orange	1.7	1.1	2.3	1.6	3.3	2.2	4.8	3.2	8.0	5.3
Grapes	1.5	1.0	2.5	1.7	4.1	2.7	6.7	4.5	12.0	7.9
Palm trees	4.0	2.7	6.8	4.5	11.0	7.3	18.0	12.0	32.0	21.0
Apricots	1.6	1.1	2.0	1.3	2.6	1.8	3.7	2.5	5.8	3.8
Almonds	1.5	1.0	2.0	1.4	2.8	1.9	4.1	2.8	6.8	4.5
Apples	1.5	1.0	2.1	1.4	2.9	1.9	4.3	2.9	7.0	4.7
Field Crops										
Wheat	6.0	4.0	7.4	4.9	9.5	6.3	13.0	8.7	30.0	8.7
Beans	4.9	3.3	70.5	3.8	7.0	4.7	9.1	6.0	13.0	8.8
Rice	3. 0	2.0	3.8	2.6	5.1	3.4	7.2	4.8	11.0	7.6
Sugar beet	7.0	4.7	8.7	3.8	11.0	7.5	15.0	10.0	24.0	16.0
Corn	1.7	1.1	2.5	1.7	3.8	2.5	5.9	3.9	10.0	6.7
Peanuts	3.2	2.1	3.5	2.4	4.1	2.7	4.9	3.3	6.6	4.4
Fava beans	1.5	1.1	2.6	1.8	4.3	2.0	6.8	4.5	12.0	8.0

II.4.Can we reuse brine water for irrigating plants ?

Yes, reusing water for plant irrigation is possible, but only under certain agricultural circumstances. When used in agriculture, brine solutions need to include a certain amount of solid components and be entirely devoid of any harmful chemicals. Desalination of water allows for the diluting of saline rinse water **(samco,2022).**Reverse osmosis technology and the study of plants that can tolerate salty conditions are two techniques for desalinating water. While essential criteria for plant growth are retained, salt is eliminated throughout the treatment procedure. Because cleaned wastewater includes a variety of nutrients, it may also be utilized as plant fertilizer. Brine waste can be used as a liquid fertilizer **(Charlotte,2024)** .

II.5.Conclusion

Although using saline water for irrigation has given us a lot of options and solutions, it is important to take into account elements like the salt of the soil, which is equally important for plant growth, and the salinity of the water itself. Furthermore, the techniques employed have a significant impact on the distribution and concentration of salt. Certain plant species can withstand elevated salinities, and treatment techniques enable us to utilize water that is entirely devoid of salt and its byproducts, which we may subsequently apply as a liquid fertilizer.

The practical part

Chapter III: Materials and methods

III.1. Presentation of the desalination station

III.1.1 History

The 19 Mars desalination plant is located in the El Oued province. Named after OTHMEN GUEDIRI, it was opened in 2020 with a production capacity of 30,000 (m^3/d) to desalinate and improve the quality of water. It serves all living of the provincial capital distributed among 11 reservoirs.

Figure 5: The 19 March demineralization station

III.1.2 Technical description

The aim of establishing the plant is to enhance and reinforce the water supply process and to optimize water facilities, adhering to the physical and chemical standards of the World Health Organization. Equipped with the latest technologies, the laboratory detects any anomalies that may pose a risk to public health. The plant operates on groundwater from the Albien aquifers, boasting a daily production capacity of 30,000 (m^3). It has a production capacity of 10,000 $m^3$with two reservoirs of 5,000 (m^3). The technology used in the plant is reverse osmosis, a process that transfers salts from a higher concentration medium to a lower one by applying hydraulic pressure greater than the osmotic pressure. It utilizes three Albien aquifers, with temperatures reaching up to 60 (C°) distributed throughout the province, producing water at a temperature below 25 (C°) **(Newspaper,2020)**. The Albien layer is considered the largest reservoir in the desert, consisting of sandy clay with a depth of 1800 (Km) , where the water is very hot **(Jari and bin Raghdah, 2018)**.

Technical characteristics of the artesian wells (A. O. W):

a. ELCHOUHADA Well :

Depth: 1800 km; Débit:490(m^3/h) ; TDS: 2 (g/l) ; Temperature: 60(C°)

b. ROUTE TOUGGOURT well :

Depth: 1800 km; Débit:485(m^3/h) ; TDS: 2 (g/l) ; Temperature: 60 (C°)

c. 19 March:

Depth: 1800 km; Débit:300(m^3/h) ; TDS: 2 (g/l); Temperature: 58 (C°)

III.2. Materials and methods (A.O.W):

III.2.1. Devices

- Sand filter backwashing station.
- Membrane cleaning station.
- Drinking water pumping station.
- Chemical preparation and dosing station.
- Service water station.

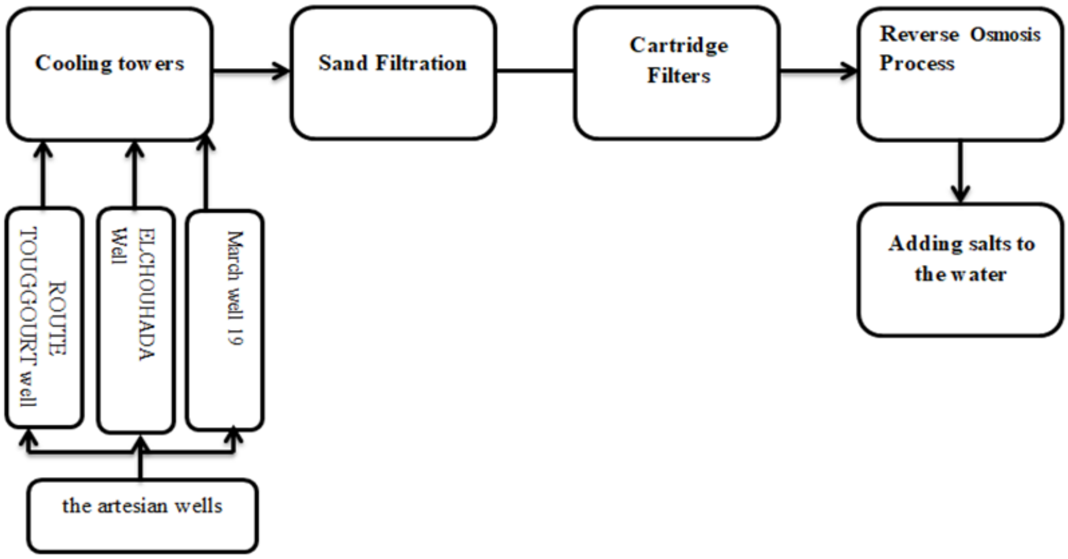


Figure 6: simplified plan for the stages of water desalination**.**

III.2.2. Experimental steps

III.2.2.1 Primary Treatment:

The water from the wells reaches a temperature of 60 degrees Celsius, and it is cooled down through cooling towers to reach 30 degrees Celsius. Raw water contains salts, dissolved gases, and mineral ions, which can cause clogging and corrosion issues. It also contains microorganisms that may cause diseases. These phenomena are treated by injecting isolation agents or reducing the formation of calcium carbonate and calcium hypochlorite for disinfection. The detecting agents are injected before the static mixer, with a flow rate of 3800(m^3/d).

A. Sand Filtration:

Sand filters operate at a filtration rate ranging from 10 to 15mm/H. They are divided into 6 sand filters to remove suspended solids, distributed among layers of gravel, sand, and anthracite. Te filters are washed with water and air using washing pumps.

B. Cartridge Filters:

Before the cartridge filters, there are two points for removing free chlorine by injecting sodium met abisulfite, and a leak preventer to prevent lime and algae deposition in the reverse osmosis process.

C. Reverse Osmosis Process:

The station operates using reverse osmosis technology to desalinate water by applying pressure to the solution to improve desalination. It has a production capacity of up to 22,500 (m^3) per day with a conversion rate of 75.1(%). The final product is placed with the filtered water in a basin with a capacity of 5000 × 2 (m^3).

D. Membrane Cleaning:

Membrane cleaning in the station is done through chemical cleaning once or twice a year. The Clean in Place (CIP) cleaning system works to reduce membrane fouling and thereby extend its lifespan.

III.2.2.2. Post-treatment:

A. Mixing Principle:

Drinking reverse osmosis water is not recommended as it does not meet drinking water quality standards and lacks essential minerals. To address this, there are two primary methods:

1. Adding salts to the water.
2. Mixing a portion of pre-treated water with reverse osmosis water.

III.2.2.3. The used tools and devices:

Table2: tools and solutions used.

The devices	The tools	Solution
• The measuring device "HANNA" • The scale" KERN" • MAGNETIC STIRRER • Manual welding tool	• Beaker"100 ml" • Seedling trays • Container • filter paper • flask • basins" Plastic containers 22 l" colander • Fertilized soil "tourbe 240-80 LT" • Sand • synthetic organic fertilizer • Gloves • Red round beet seeds. • Bottles. • Iron wire • Wooden stick. • Drip Tuping	• Distilled water • Drinking water • Saltwater • Tap water

A. Work Method:

A.1. stages of farming:

To plant red beetroot, follow these steps:

Primary cultivation → The second stage → The third stage.

Primary cultivation

1. Washing the Seeds28g.
2. Soaking the Seeds.
3. Separate and strain the seeds from the water.
4. Preparing Seedling Trays.
5. Planting the Seeds
6. Watering.
7. Monitoring Seedling Growth.
8. Exposure to Sunlight and Shade **(B. P. G ,2014)**
9. Use a sprinkler irrigation system. **(bekkari and kadouda ,2023).**
10. Planting date at the faculty Technology on March 12, 2024.

The second stage

1. Transferring Seedlings After 15 days.
2. Washing Sand
3. Soil and Water Mixture.
4. Repetition for Salt Removal. (bekkari and kadouda ,2023)
5. Drying
6. Preparation of Pots.
7. Mixing and Division of Seedlings.
8. Watering continues using a sprinkler irrigation system.
9. Irrigation Scheduling. Irrigation scheduling involves organizing water quantities based on soil moisture and plant needs. **(A Almhab ,2011)** Typically, irrigation is done three times perek.

The third stage.

1. Division of Samples:

   Posts 9 and 8: irrigated with 100% saline water.

   Posts 6 and 7: irrigated with mixed water (50% tap water, 50% saline) water.

   Post 5: irrigated with tap water.

2. Change to Drip Irrigation System: The irrigation system is changed to drip irrigation,. This system directly supplies plants with continuous or intermittent quantities of water. **(Hassan M H and Mohsen H N,2019)**

Figure 7: Planting stages diagram

A.2. The analyses:

❖ **Primary cultivation**

A sample is taken from the water in which the beet seeds were soaked **(Figure8)**, and necessary analyses are conducted, pH, temperature, salinity, and concentration of dissolved salts, Conductivity using a device called "HANNA". The same analyses are measured for irrigation water **(Figure9)** and agricultural drainage water using the same method **(Figure10).** However, the electrodes must be washed to ensure accuracy in the readings.

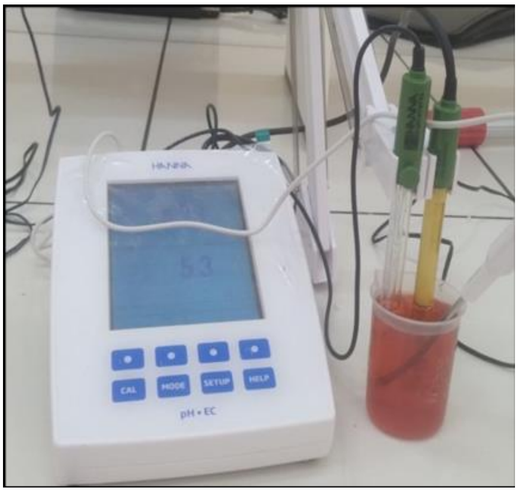


Figure 8: the analysis of water in which the seeds are soaked (ouada R, Bey A.2024).

Figure 9: water analysis irrigation (ouada R, Bey A.2024).

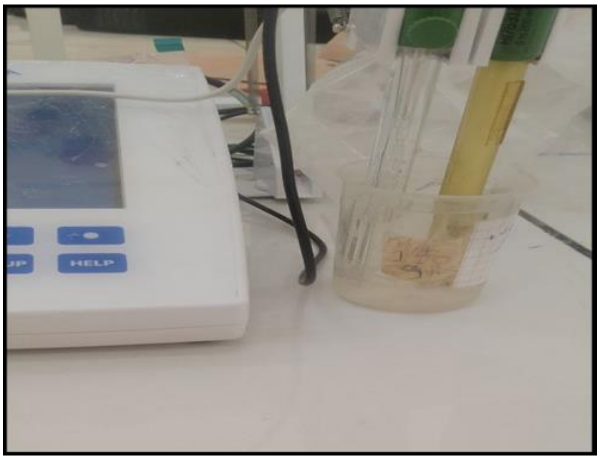


Figure10: Agricultural drainage analysis (ouada R, Bey A.2024).

❖ **The second stage**

To determine the electrical conductivity of soil, the (5:1 weight/volume) method is followed. 20 grams of dry soil is weighed in a beaker **(Figure10)**, to which 100 milliliters of distilled water, free from minerals, is added. The beaker is then placed in a magnetic stirrer and mixed for a full hour at room temperature (25°C) **(Figure11)**. After mixing, it is left to settle for 30 minutes **(Figure12)**. The probes are then immersed**(Figure13)**, and the reading is taken **(FAO,2021).**

Figure 10: The sample weight 20g of soil (ouada R , Bey A.2024)

Figure 11 : mixture of water and sand(ouada R , Bey A.2024)

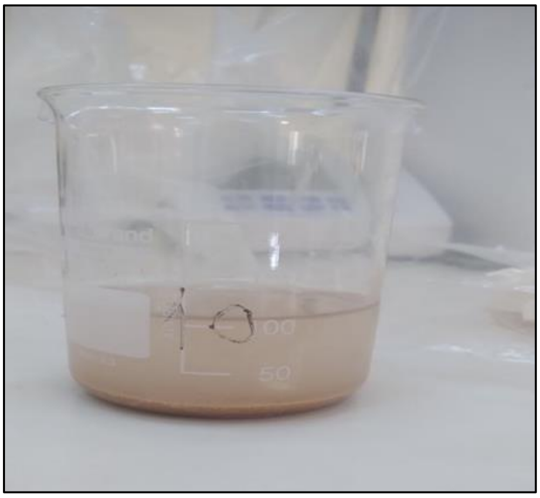


Figure 12: Post-Blender Solution (ouada R , Bey A.2024)

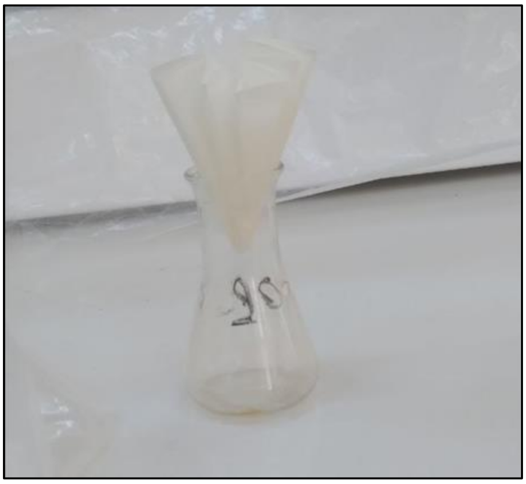


Figure 13 : Separating Soil Water from (ouada R , Bey A.2024).

❖

❖ **The third stage.**

Sample is taken from each type of water (0%, 50%, 100% salinity) and analyses are conducted for, each type. Subsequently **(Figure14),** an analysis is performed for agricultural drainage water.

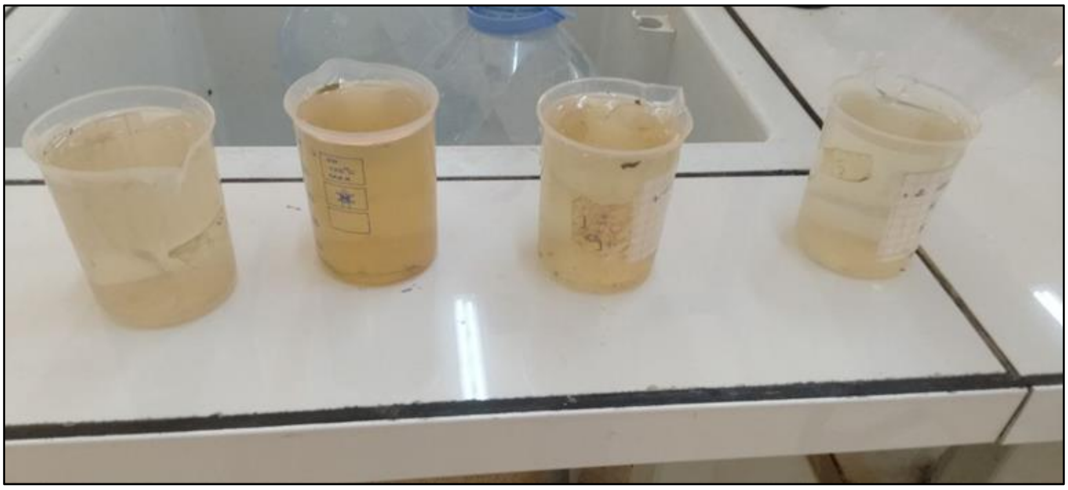


Figure14: Agricultural drainage water samples (ouada R , Bey A.2024).

III.3. The results:

III.3.1-Stage One:

3-1-1- pH:

Graph representing the changes in pH of irrigation water and agricultural drainage water over time (days) **(Figure 15)**.

❖ **Irrigation water:**

Highest value: 7.95 on March 20 .

Lowest value: 7.44 on March 18.

Average values: 8.012.

❖ **drainage water:**

Highest value: 7.45 on March 25.

Lowest value: 6.03 on March 14.

Average values: 6.77.

Irrigation water is more acidic compared to agricultural drainage water, which ranges from acidic to less acidic. This difference is attributed to the accumulation of ions in the soil and meeting the nutritional needs of sugar beet seeds, which require nutrients.

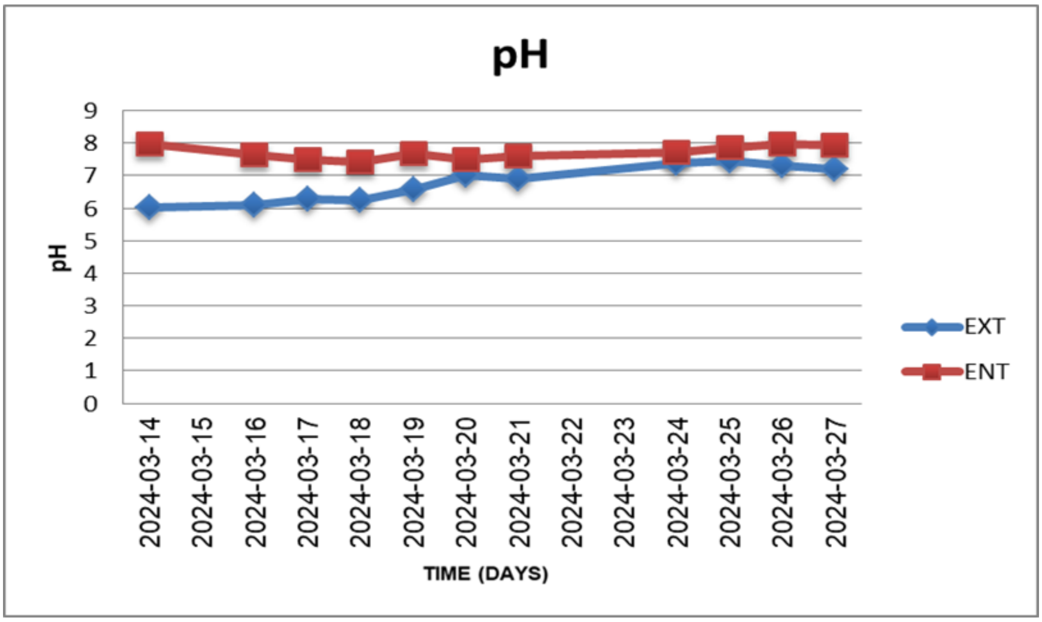


Figure 15: pH Variation Curve of Irrigation Water and Agricultural Drainage Water Over Time(days)**.**

3-1-2- Total Dissolved Salts in Water:

graph representing the changes in dissolved salts in irrigation water and agricultural drainage water over time (days) **(Figure 16**).

❖ **irrigation water:**

Highest value: 2.067(ppt) on March 27.

Lowest value: 1.089(ppt) on March 14.

Average values: 1.768 (ppt).

❖ **drainage water:**

Highest value: 4.8(ppt) on March 25.

Lowest value: 0(ppt) on March 14 .

Average values: 2.9(ppt).

Irrigation water contains a moderate concentration of dissolved salts, which does not affect the growth of beet plants. Conversely, agricultural drainage water has a high concentration of dissolved salts, which is attributed to soil leaching or beet plants.

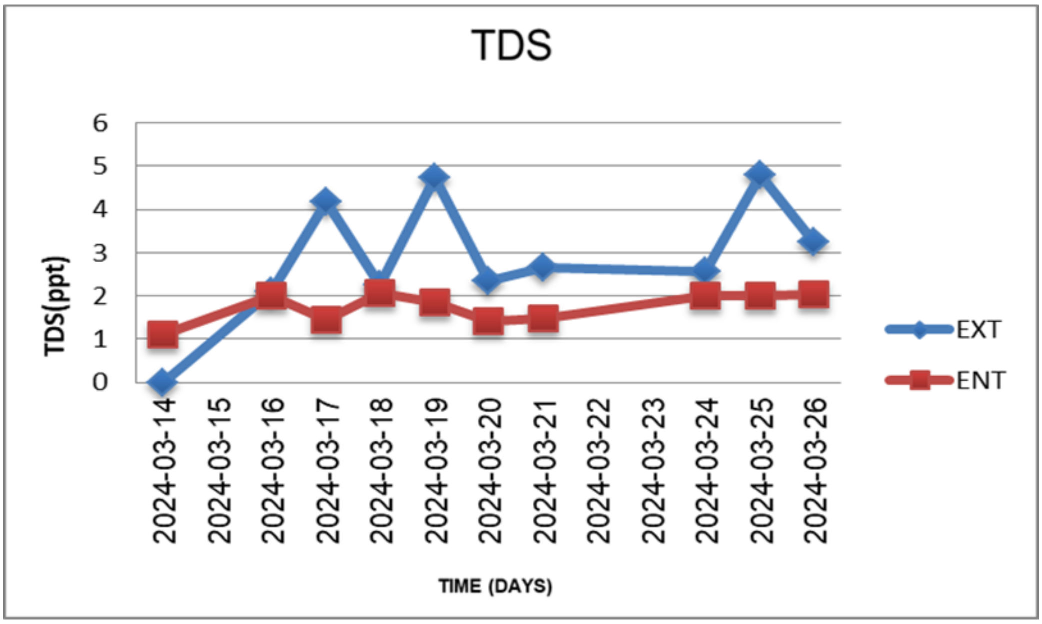


Figure 16: Variation Curve of total Dissolved Salts in Irrigation Water and Agricultural Drainage Water Over Time(days).

3-1-3- Salinity

graph representing the changes in salinity of irrigation water and agricultural drainage water over time (days) **(Figure 17)**.

❖ **irrigation water:**

Highest value: 8.1(%) on March 27 .

Lowest value: 4.3(%)on March 14.

Average values. 6.91 (%).

❖ **drainage water:**

Highest value: 18.8(%) on March 25.

Lowest value: 0(%) on March 14 .

Average values: 10.52(%) .

Irrigation water is considered moderately saline, with values free from excess salinity. Meanwhile, agricultural drainage water has high salinity levels, indicating a high concentration of salinity.

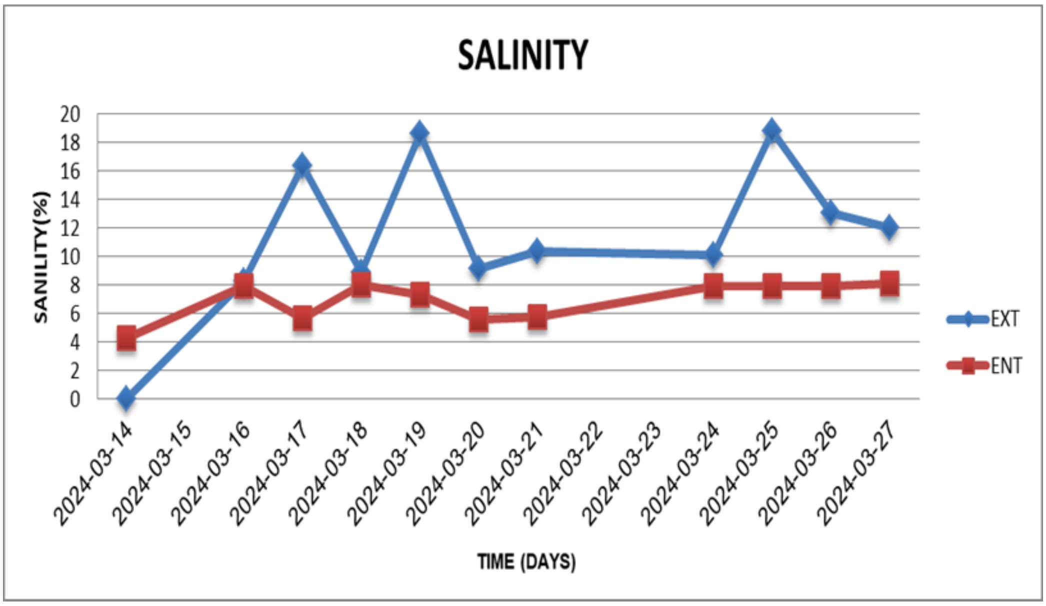


Figure 17: Salinity Variation of Irrigation Water and Agricultural Drainage Water Over Time(days).

3-1-4- electrical conductivity

graph representing the electrical conductivity of irrigation water and agricultural drainage over time (day) **(Figure 18)**.

- **irrigation water:**

  Highest value: 4.126 (ms/cm) on March 27.

  Lowest value: 2.175(ms/cm) on March 14.

  Average values: 3.5357 (ms/cm).

- **drainage water:**

  Highest value: 9.601(ms/cm)on March 25.

  Lowest value: 0.175(ms/cm)on March 14 .

  Average values: 5.72(ms/cm).

The electrical conductivity values of irrigation water are moderate, indicating the presence of dissolved substances that facilitate electrical conductivity. However, agricultural drainage. water is much higher, indicating a very high concentration of dissolved substances, likely due to high salt concentrations.

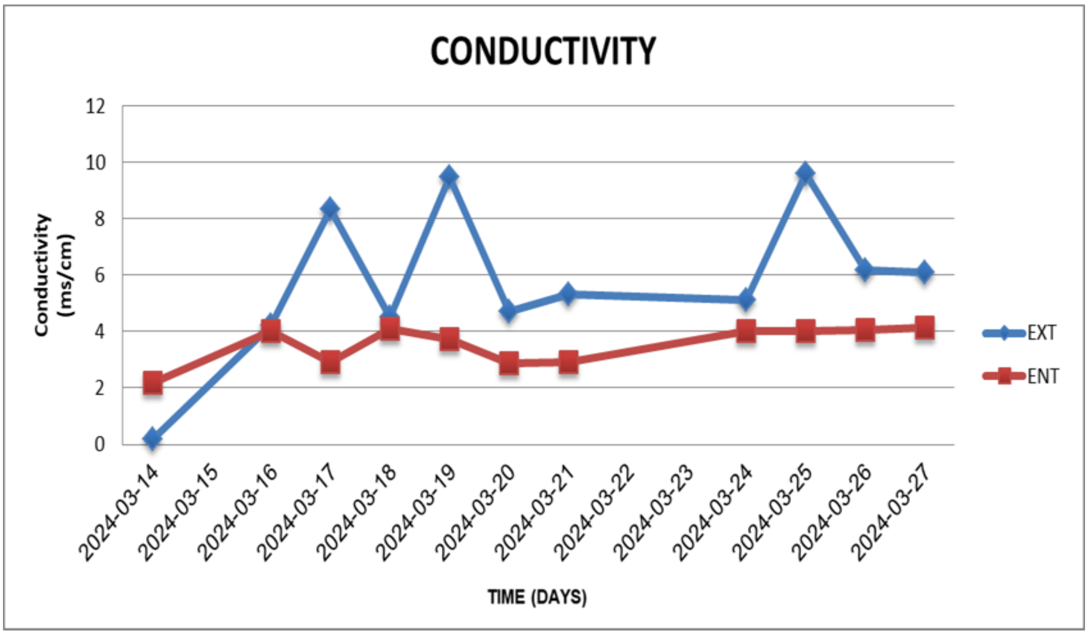


Figure 18: the Variation Curve of Electrical Conductivity in Irrigation Water and Agricultural Drainage Water Over Time (days).

3-1-5-temperature

Graph representing the temperature variations for irrigation water and agricultural drainage water Over Time **(Figure 19)**.

❖ **irrigation water:**

Highest value: 22.9(°C)on March 25.

Lowest value: 20.4(°C) on March 19.

Average values: 22.84 (°C).

❖ **drainage water:**

Highest value: 33(°C) on March 16.

Lowest value: 24(°C) on March 24.

Average values: 28.27(°C).

The slight variation in the average temperature compared to the average values for water irrigation and agricultural drainage is attributed to external factors that govern temperature fluctuations.Temperature is a crucial factor as it exhibits an a direct corrlation with electrical conductivity and plays a significant role in the solubility of salts .**(Bouchemal.2017).**

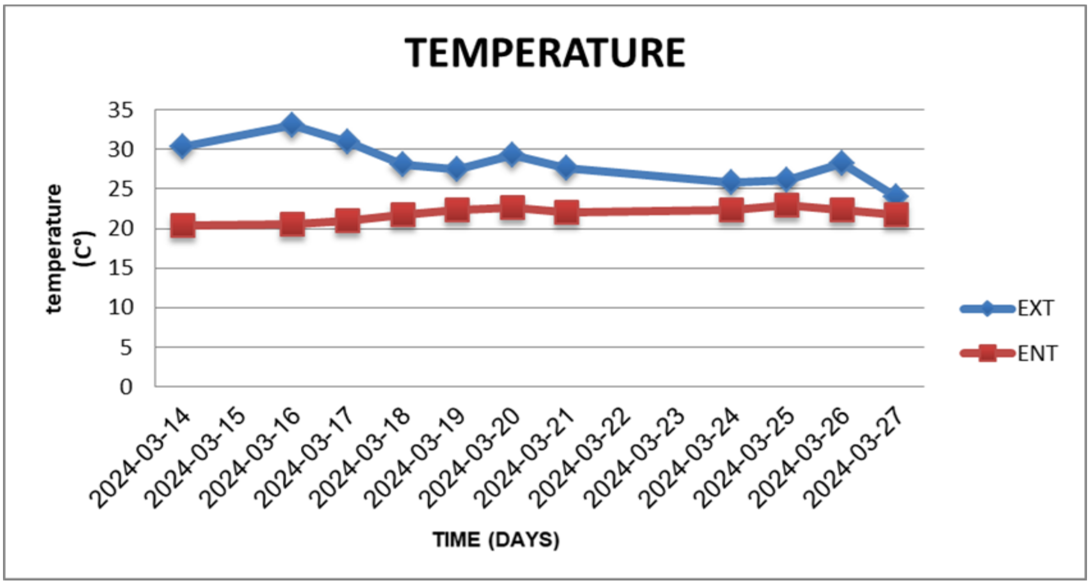


Figure 19: The Temperature Variation Curve in Irrigation Water and Agricultural Drainage Water Over Time(days).

III.3.2. The second stage:

3-2-1 pH

1- Sample 9:

Graph representing the changes in pH of irrigation water and agricultural drainage water over time (days) **(Figure 20).**

❖ **irrigation water:**

Highest value: 8.35 on APRIL 14.

Lowest value: 7.72 on APRIL 9.

Average values: 8.012.

❖ **drainage water:**

Highest value: 8.02 on May 02.

Lowest value:7.36 on APRIL14.

Average values: 7.71.

The values of irrigation water are considered moderately neutral, indicating that the water is suitable for agricultural use without affecting the soil or plants. However, agricultural drainage water is considered alkaline, which is attributed to fertilizer usage, affecting the drainage water.

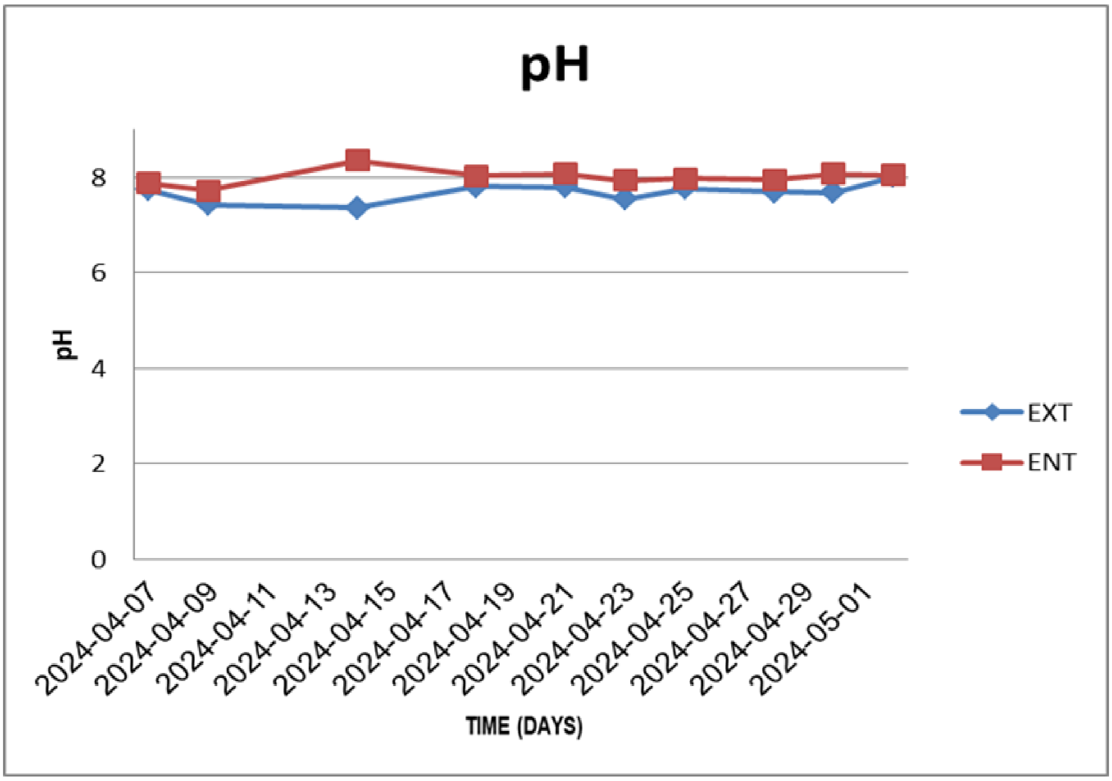


Figure 20: pH Variation Curve of Irrigation Water and Agricultural Drainage Water Over Time(days).

2-Sample 8:

Graph representing the changes in pH of irrigation water and agricultural drainage water over time (days) **(Figure 21)**.

❖ **irrigation water:**

Highest value: 8.35 on APRIL 14.

Lowest value: 7.72 on APRIL 9.

Average values: 8.012.

❖ **drainage water:**

Highest value: 8.26on APRIL 21.

Lowest value: 7.42on APRIL9 .

Average values: 7.81.

The pH values of irrigation water are slightly higher than those of agricultural drainage water. This difference is due to the use of fertilizers and dissolved organic matter. Both types of water are nearly neutral with a slight tendency towards alkalinity. This indicates that the pH level of the water is not acidic enough to negatively affect the plants.

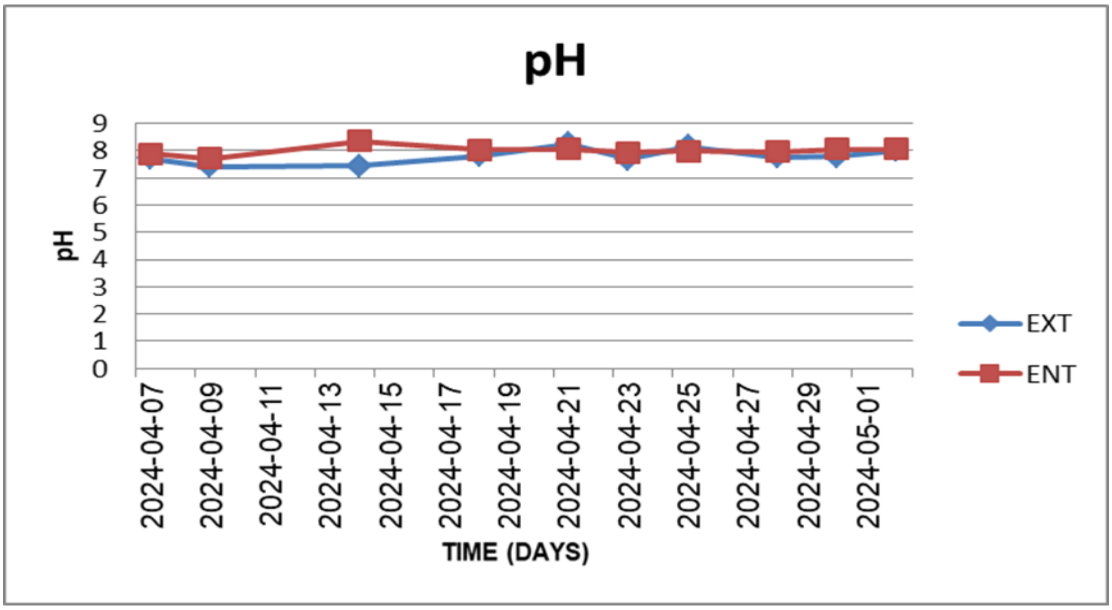


Figure 21: pH Variation Curve of Irrigation Water and Agricultural Drainage Water Over Time(days).

3- Sample 7:

Graph representing the changes in pH of irrigation water and agricultural drainage water over time (days) **(Figure 22)**.

- **irrigation water:**

  Highest value: 8.35 on APRIL 14.

  Lowest value: 7.72 on APRIL 9.

  Average values: 8.012.

- **drainage water:**

  Highest value: 8.02 on May 02.

  Lowest value:7.37on APRIL14 .

  Average values:8.0.

The values of irrigation water and agricultural drainage water are close, with slight differences, and values around 7 are considered ideal for plants.

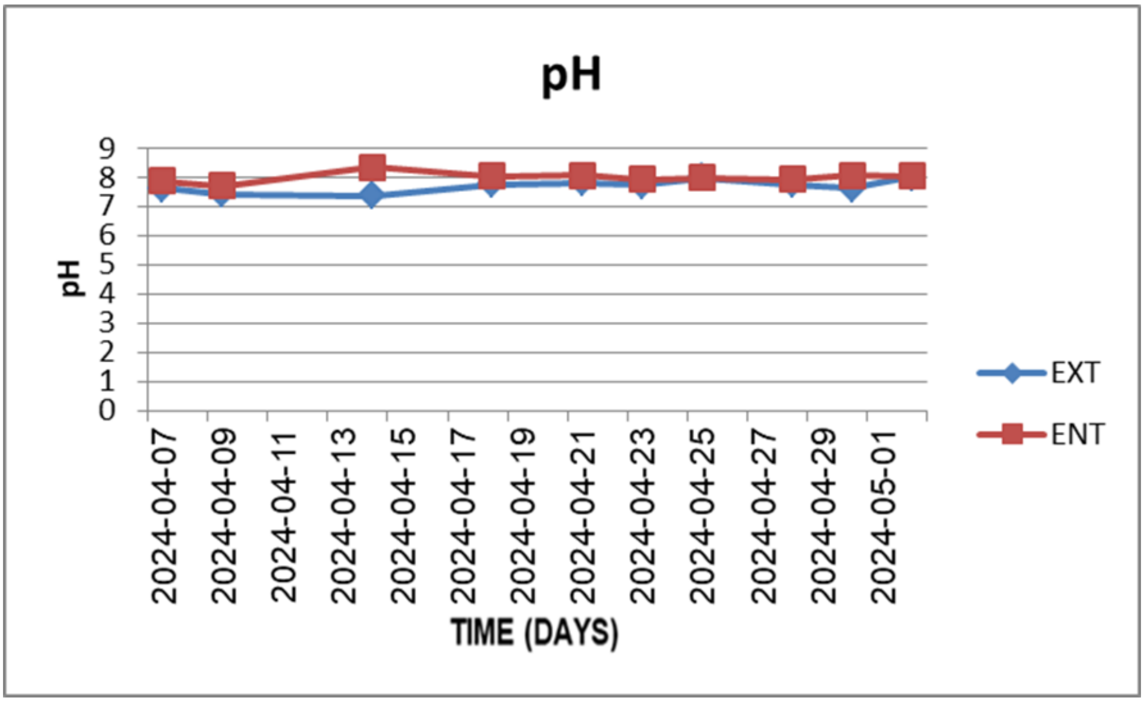


Figure 22: pH Variation Curve of Irrigation Water and Agricultural Drainage Water Over Time(days).

4- Sample 6:

Graph representing the changes in pH of irrigation water and agricultural drainage water over time (days) **(Figure 23)**.

- **irrigation water:**

  Highest value: 8.35 on APRIL 14.

  Lowest value: 7.72 on APRIL 9.

  Average values: 8.012.

- **drainage water:**

  Highest value: 7.97on APRIL 25.

  Lowest value: 6.37on APRIL09 .

  Average values: 7.56.

The pH values for both agricultural drainage water and irrigation water are generally similar, with irrigation water being slightly more alkaline. Both types of water provide a suitable environment for plant growth, as the values fall within the optimal range for most plants.

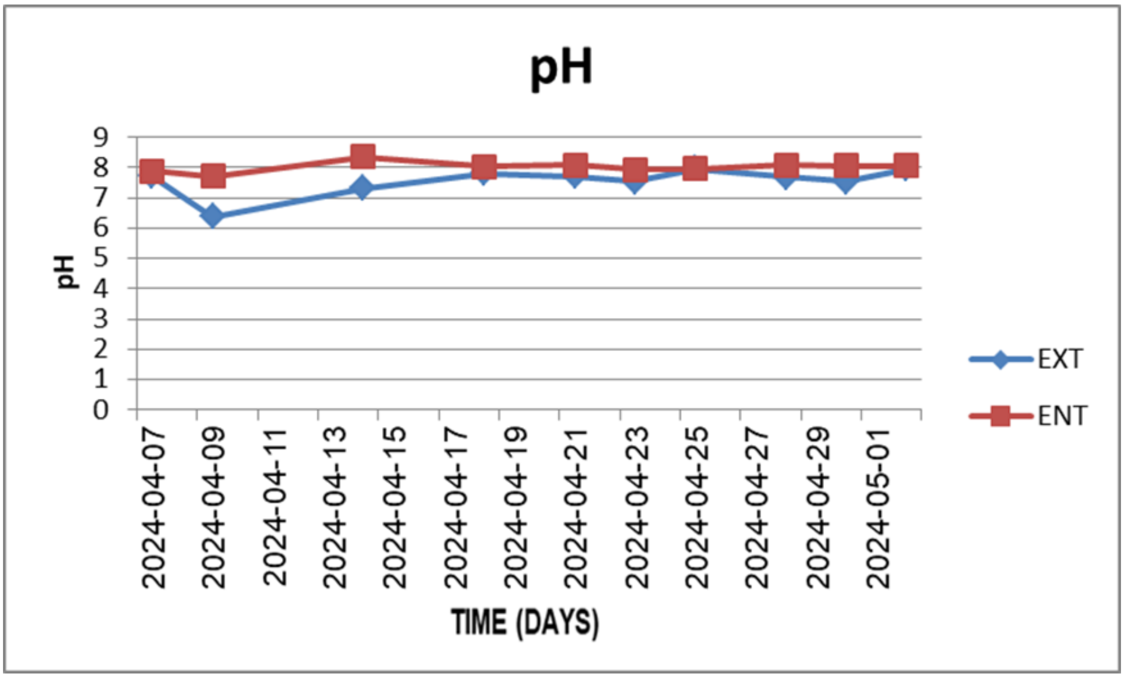


Figure 23: pH Variation Curve of Irrigation Water and Agricultural Drainage Water Over Time(days).

5- Sample 5:

Graph representing the changes in pH of irrigation water and agricultural drainage water over time (days) **(Figure 24).**

❖ **irrigation water:**

Highest value: 8.35 on APRIL 14.

Lowest value: 7.72 on APRIL 9.

Average values: 8.012.

❖ **drainage water:**

Highest value: 7.96 on MAY 02.

Lowest value: 7.44on APRIL09 .

Average values: 7.72.

The pH value of agricultural runoff water appears neutral compared to the average value of irrigation water. The lower pH values in agricultural runoff water are due to the soil composition and the type of crops grown. The interaction between soil and plants can influence the pH level of the water, making it more balanced.

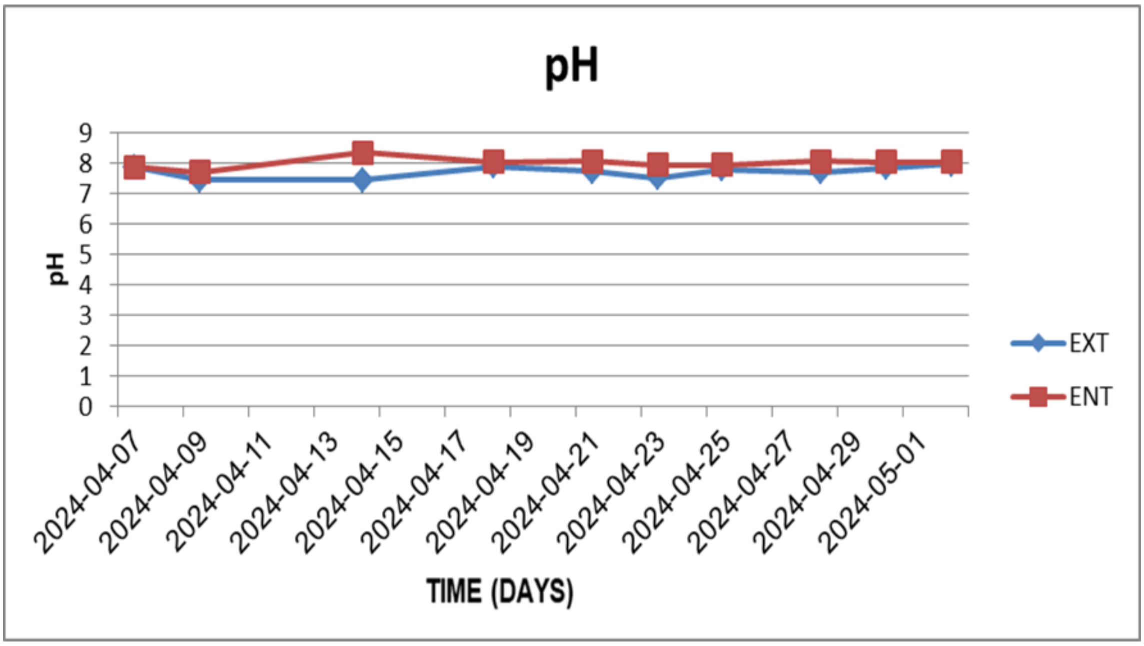


Figure24: pH Variation Curve of Irrigation Water and Agricultural Drainage Water Over Time(days).

3-2-2- TDS:

1- Sample 9:

Graph representing the changes in Total dissolved salts in irrigation water and agricultural drainage water over time (days) **(Figure 25)**.

❖ **irrigation water:**

Highest value: 2.046 (PPT) on APRIL 07.

Lowest value: 0 (PPT) on APRIL14 .

Average values: 1.768 (PPT).

❖ **drainage water:**

Highest value: 4.687 (PPT) on APRIL09.

Lowest value: 3.490 (PPT) on APRIL 18.

Average values: 8(PPT).

It is noted that the levels of total dissolved salts in agricultural drainage water are significantly higher than irrigation water. This is attributed to the fact that irrigation water is usually treated, whereas agricultural drainage water is influenced by soil and fertilizers.

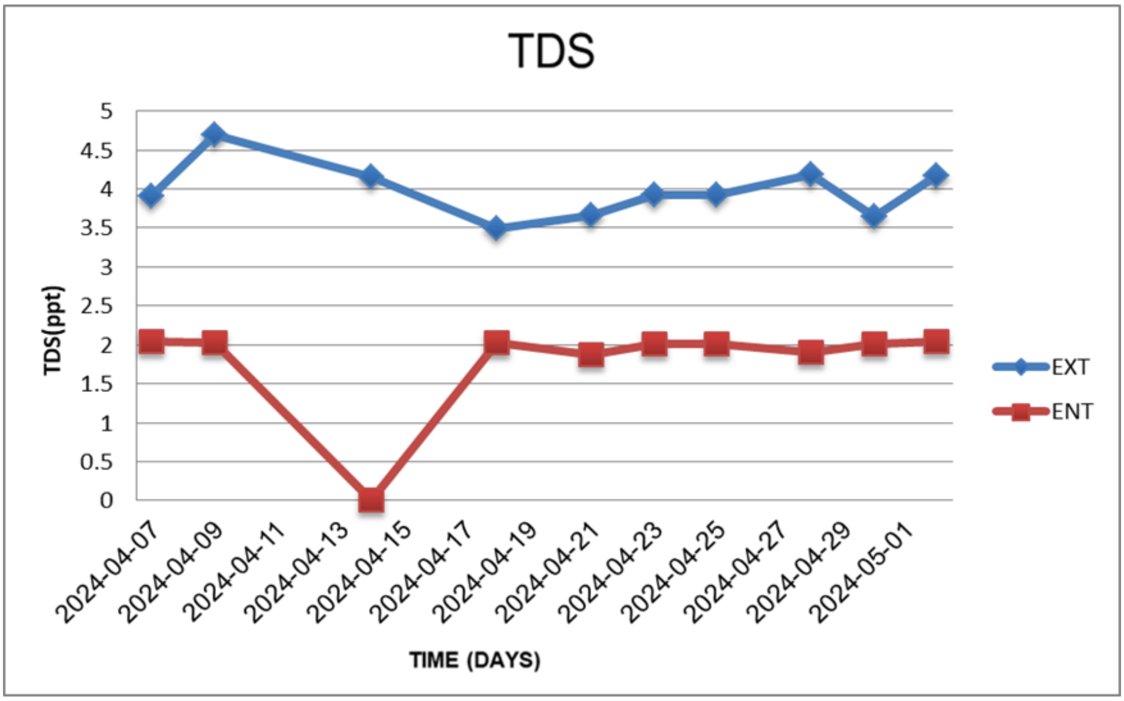


Figure 25: Variation Curve of Total Dissolved Salts in Irrigation Water and Agricultural Drainage Water Over Time(days).

2- Sample 8:

Graph representing the changes in Total dissolved salts in irrigation water and agricultural drainage water over time (days) **(Figure 26)**.

❖ **irrigation water:**

Highest value: 2.046 (PPT) on APRIL 07.

Lowest value: 1.726 (PPT) on MAY02 .

Average values: 1.768 (PPT).

❖ **drainage water:**

Highest value: 6.506 (PPT) on May02.

Lowest value: 3.096 (PPT) on APRIL21.

Average values: 1.887 (PPT).

The salt level in irrigation water is lower than in agricultural drainage water, due to the added substances such as fertilizers that increase the salt content in the drainage water.

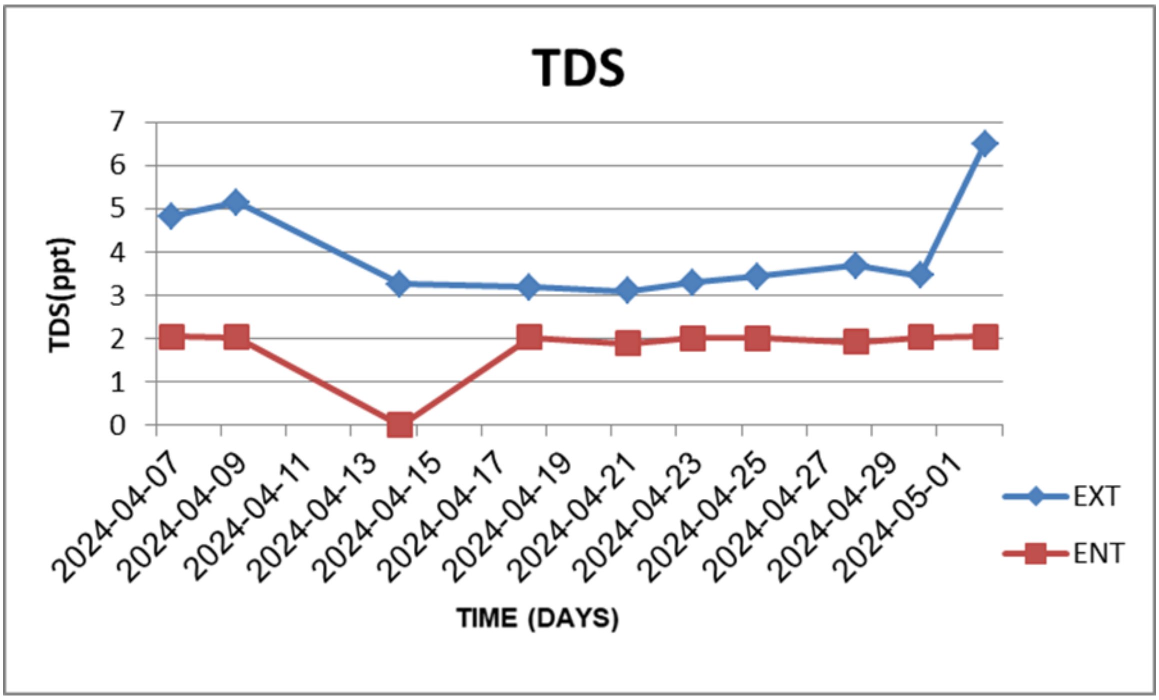


Figure26: Variation Curve of Total Dissolved Salts in Irrigation Water and Agricultural Drainage Water Over Time(days).

3-Sample 7:

Graph representing the changes in Total dissolved salts in irrigation water and agricultural drainage water over time (days) **(Figure 27)**.

- **irrigation water:**

  Highest value: 2.046 (PPT) on APRIL 07.

  Lowest value: 0 (PPT) on APRIL14 .

  Average values: 1.768 (PPT).

- **drainage water:**

  Highest value: 6.506 (PPT) on APRIL09.

  Lowest value: 3.189 (PPT) on APRIL 18.

  Average values: 8(PPT).

The values of irrigation water were lower compared to agricultural drainage water, and this is due to the fertilizers used in agriculture.

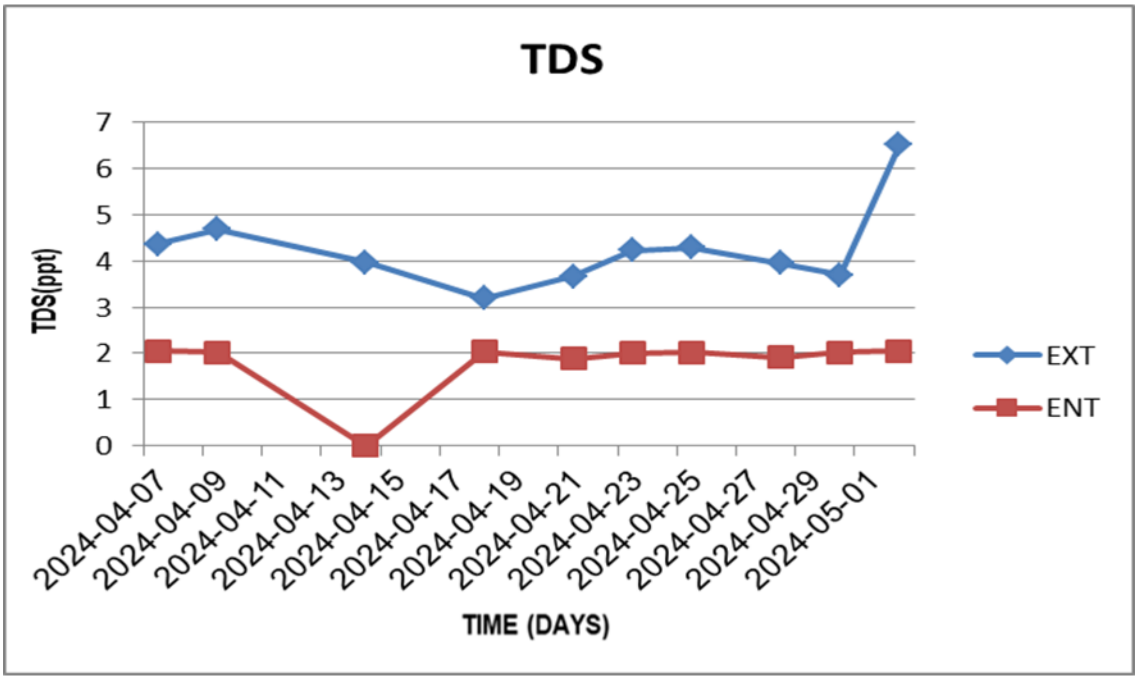


Figure 27: Variation Curve of Total Dissolved Salts in Irrigation Water and Agricultural Drainage Water Over Time(days).

4-Sample 6:

Graph representing the changes in Total dissolved salts in irrigation water and agricultural drainage water over time (days) **(Figure 28)**.

❖ **irrigation water:**

Highest value: 2.046 (PPT) on APRIL 07.

Lowest value: 0 (PPT) on APRIL14.

Average values:1.79(PPT).

❖ **drainage water:**

Highest value: 4.946 (PPT) on May02.

Lowest value: 3.309 (PPT) on APRIL 07.

Average values: 4.086 (PPT).

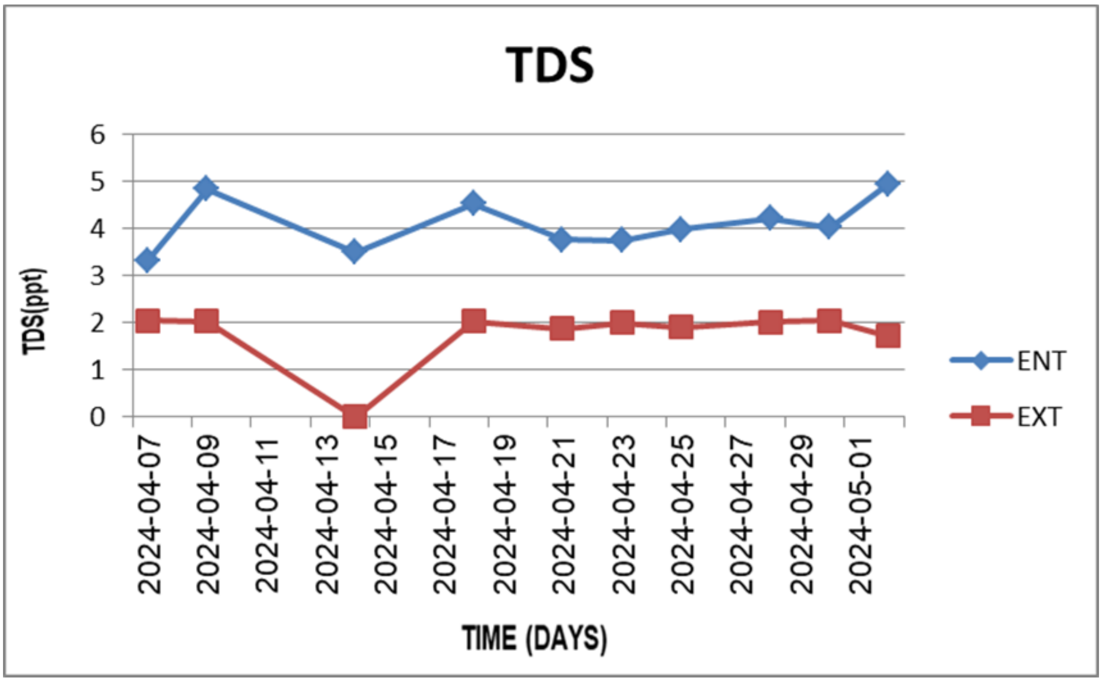


Figure 28: Variation Curve of Total Dissolved Salts in Irrigation Water and Agricultural Drainage Water Over Time(days).

5-Sample 5:

Graph representing the changes in Total dissolved salts in irrigation water and agricultural drainage water over time (days) **(Figure 29)**.

❖ **irrigation water:**

Highest value: 2.046 (PPT) on APRIL 07.

Lowest value: 0 (PPT) on APRIL14 .

Average values: 1.768 (PPT).

❖ **drainage water:**

Highest value: 5.636 (PPT) on APRIL02.

Lowest value: 2.467 (PPT) on MAY02.

Average values: 3.83 (PPT).

Total dissolved salts levels in irrigation water are low compared to those in agricultural runoff water. This is attributed to the accumulation of salts from fertilizers, which dissolve in agricultural runoff water. On the other hand, irrigation water is suitable for watering.

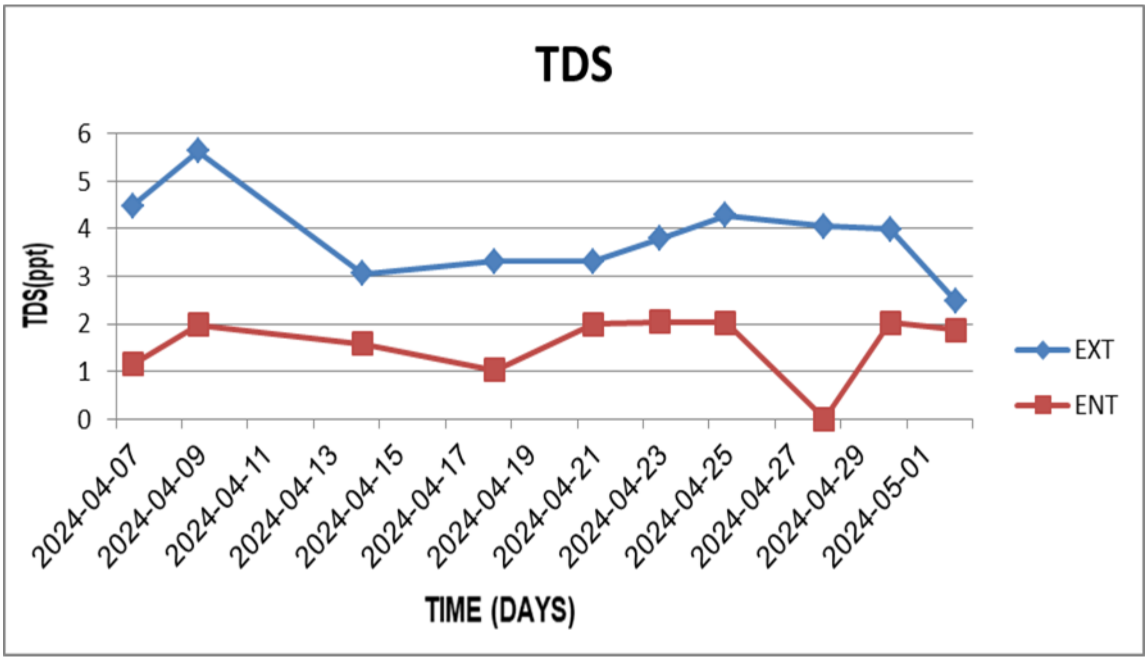


Figure 29: Variation Curve of Total Dissolved Salts in Irrigation Water and Agricultural Drainage Water Over Time(days).

3-2-3- Salinity:

1-Sample 9:

Graph representing the changes in salinity of irrigation water and agricultural drainage water over time (days) **(Figure 30)**.

❖ **irrigation water:**

Highest value: 8 (%) on APRIL 09.

Lowest value: 0 (%) on APRIL14.

Average values: 6.91 (%).

❖ **drainage water:**

Highest value: 18.30 (%) on APRIL09.

Lowest value: 13.70(%) on APRIL 18.

Average values:15.25(%).

Agricultural drainage water contains significantly higher amounts of dissolved salts compared to irrigation water. This is attributed to the influence of soil and fertilizers used, leading to elevated levels of dissolved salts in the water.

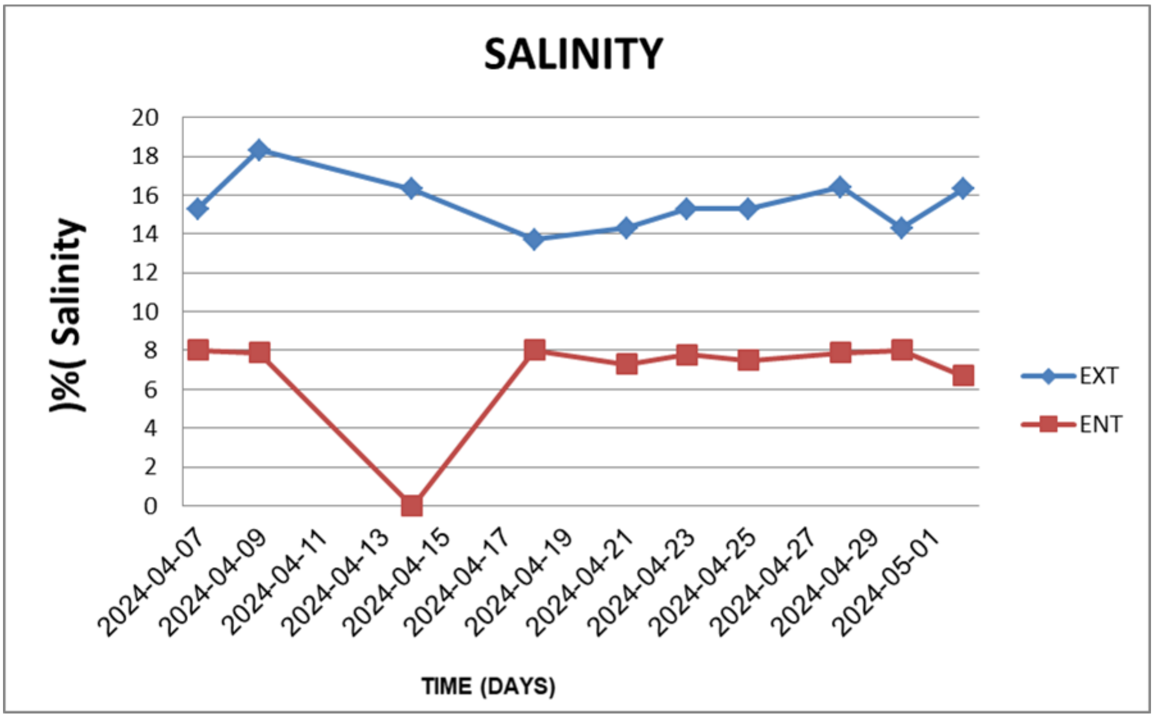


Figure 30: Salinity Variation of Irrigation Water and Agricultural Drainage Water Over Time(days).

2-Sample 8:

Graph representing the changes in salinity of irrigation water and agricultural drainage water over time (days) **(Figure 31)**.

❖ **irrigation water:**

Highest value: 8 (%) on APRIL 09.

Lowest value: 0 (%) on APRIL14 .

Average values: 6.91 (%).

❖ **drainage water:**

Highest value: 20.1 (%) on APRIL09.

Lowest value: 12.10 (%) on APRIL 18.

Average values: 14.75 (%).

The salt content in irrigation water is lower than in agricultural drainage water, making it suitable for cultivation. On the other hand, agricultural drainage water indicates soil leaching and the downward movement of salts into the water.

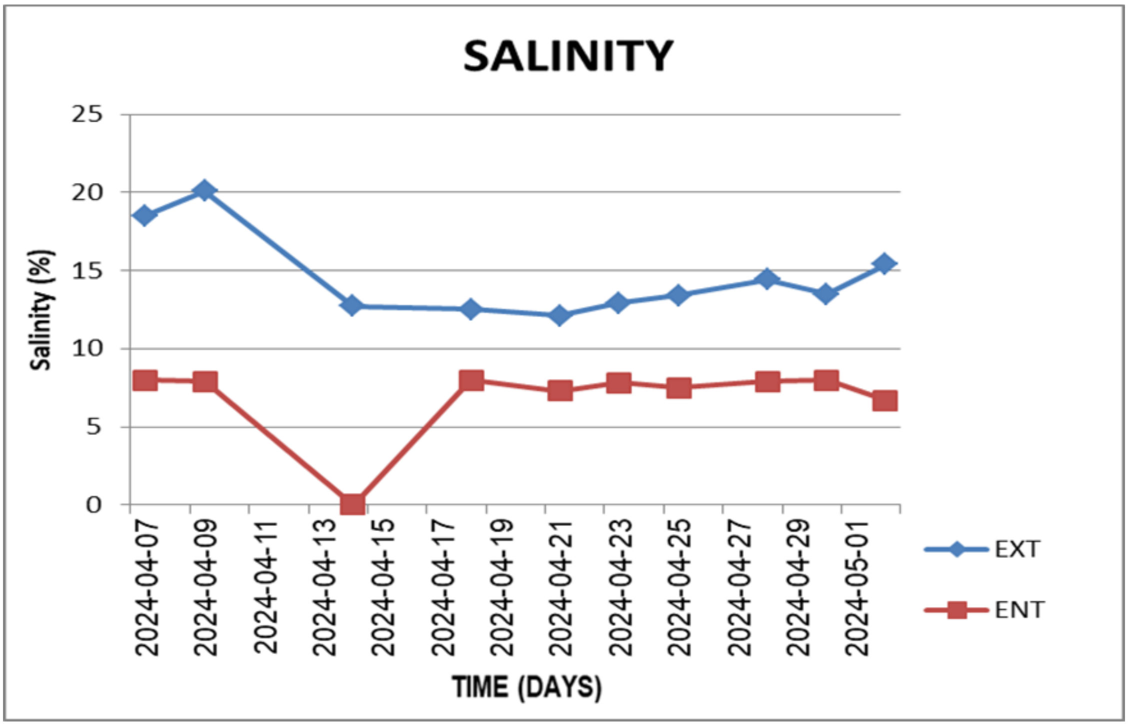


Figure31: Salinity Variation of Irrigation Water and Agricultural Drainage Water Over Time(days).

3-Sample 7:

Graph representing the changes in salinity of irrigation water and agricultural drainage water over time (days) **(Figure 32)**.

❖ **irrigation water:**

Highest value: 8 (%) on APRIL 09.

Lowest value: 0 (%) on APRIL14 .

Average values: 6.91 (%).

❖ **drainage water:**

Highest value: 18.8 (%) on APRIL09.

Lowest value: 12.5 (%) on APRIL 18.

Average values:15.25(%).

The salinity values of irrigation water are low compared to agricultural drainage water. This is because agricultural drainage water contains chemicals present in fertilizers.

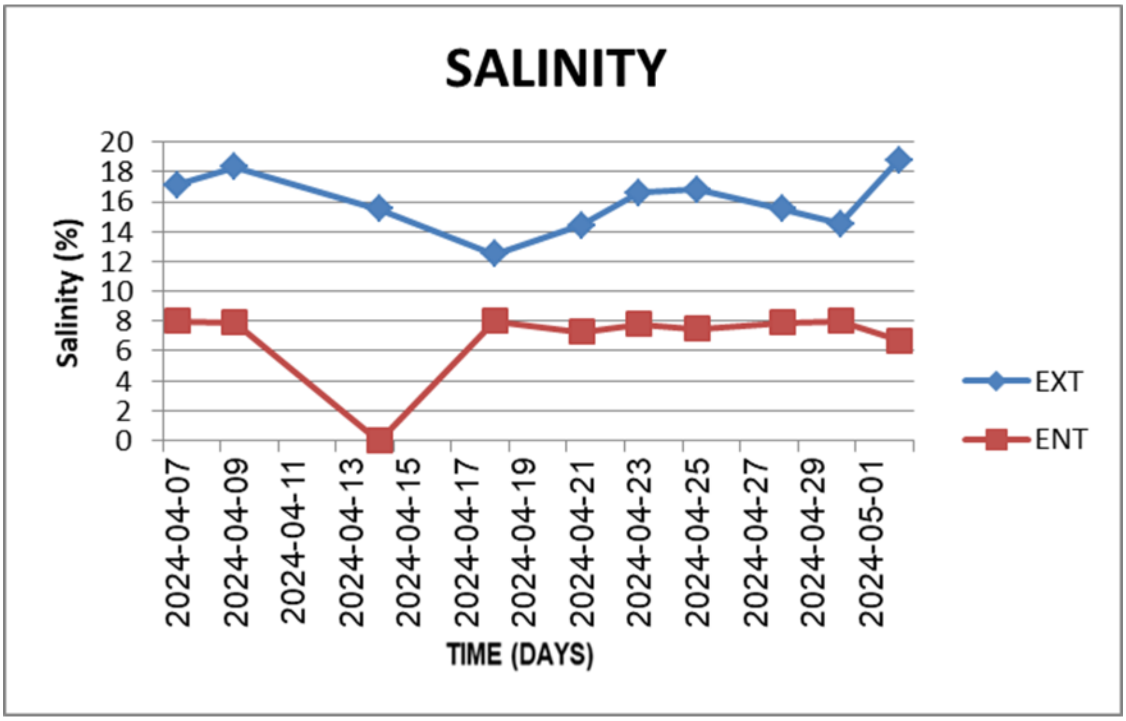


Figure 32: Salinity Variation of Irrigation Water and Agricultural Drainage Water Over Time(days).

4-Sample 6:

Graph representing the changes in salinity of irrigation water and agricultural drainage water over time (days) **(Figure 33)**.

❖ **irrigation water:**

Highest value: 8 (%) on APRIL 09.

Lowest value: 0 (%) on APRIL14.

Average values: 6.91 (%).

❖ **drainage water:**

Highest value: 19.3 (%) on APRIL09.

Lowest value: 12.9 (%) on APRIL 18.

Average values: 16 (%).

The salt content values in agricultural drainage water are significantly higher than those in irrigation water. This indicates that agricultural drainage water may contain dissolved chemicals and fertilizers, increasing the salt content. Therefore, irrigation water can be used more safely for watering plants.

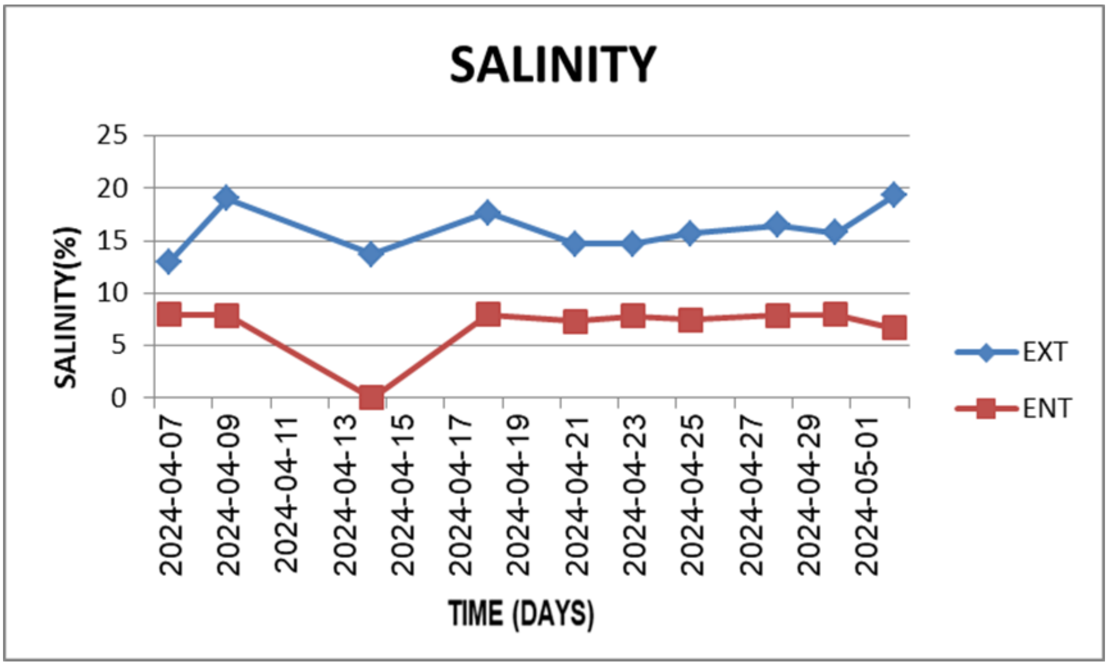


Figure 33: Salinity Variation of Irrigation Water and Agricultural Drainage Water Over Time(days).

5-Sample 5:

Graph representing the changes in salinity of irrigation water and agricultural drainage water over time (days) **(Figure 34)**.

❖ **irrigation water:**

Highest value: 8 (%) on APRIL 09.

Lowest value: 0 (%) on APRIL14 .

Average values: 6.91 (%).

❖ **drainage water:**

Highest value: 22 (%) on APRIL09.

Lowest value: 9.7 (%) on MAY 02.

Average values: 15.08 (%)

The higher salinity of agricultural runoff water compared to irrigation water is due to the impact of fertilizers and accumulated salts in the soil, which leads to increased electrical conductivity in the runoff water. In contrast, the low salinity of irrigation water does not negatively affect the soil and plants.

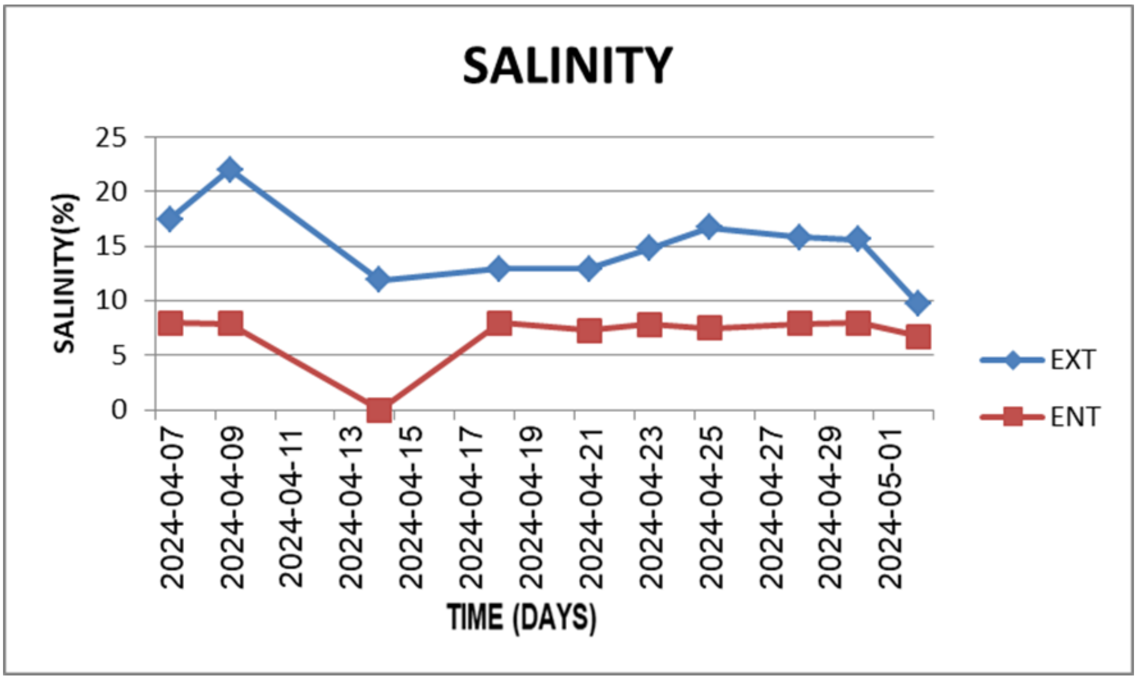


Figure34: Salinity Variation of Irrigation Water and Agricultural Drainage Water Over Time(days).

3-2-4- Conductivity:

1-Sample 9:

Graph representing the electrical conductivity of irrigation water and agricultural drainage over time (day) **(Figure 35)**.

- **irrigation water:**

  Highest value: 4.078 (ms/cm) on APRIL 30.

  Lowest value: 0.001 (ms/cm) on APRIL14.

  Average values: 3.5357 (ms/cm).

- **drainage water:**

  Highest value: 9.363 (ms/cm) on APRIL09.

  Lowest value: 7.30 (ms/cm) on APRIL 30.

  Average values:15.25 (ms/cm).

The values of agricultural irrigation water are higher than those of irrigation water, due to the elevated levels of dissolved salts in the water.

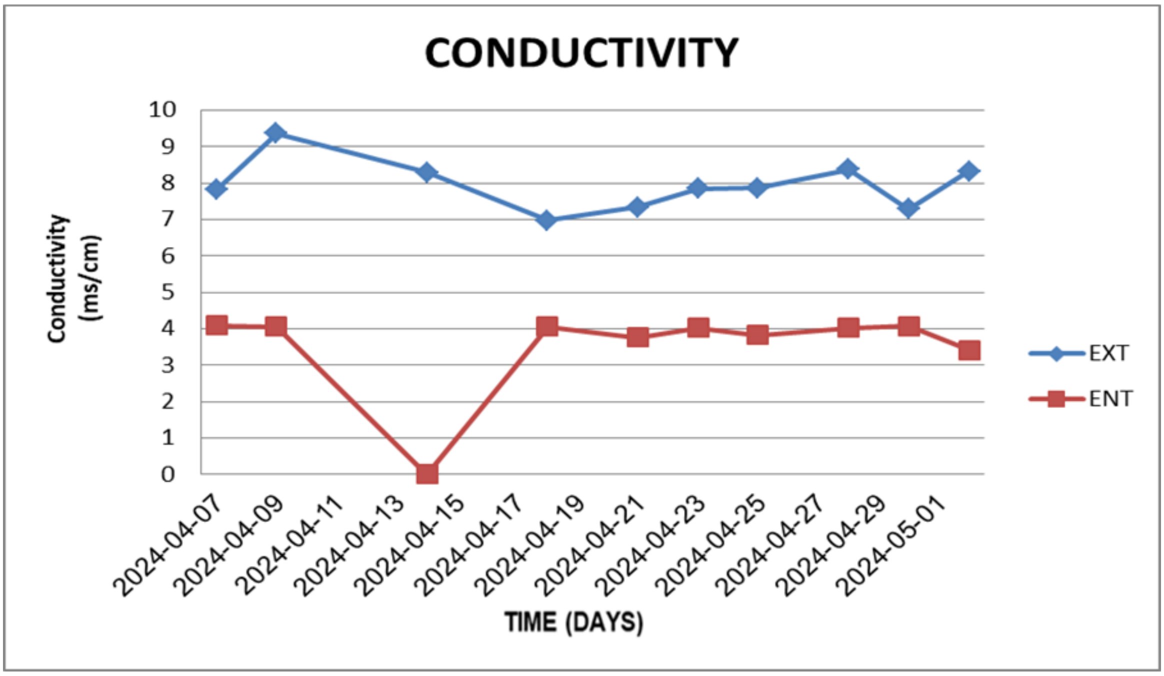


Figure 35 : Variation Curve of Electrical Conductivity in Irrigation Water and Agricultural Drainage Water Over Time (days)**.**

2-Sample 8:

Graph representing the electrical conductivity of irrigation water and agricultural drainage over time (days) **(Figure 36)**.

❖ **irrigation water:**

Highest value: 4.078 (ms/cm) on APRIL 30.

Lowest value: 0.001(ms/cm) on APRIL14 .

Average values: 3.5357 (ms/cm).

❖ **drainage water:**

Highest value: 10.29 (ms/cm) on APRIL09.

Lowest value: 6.194 (ms/cm) on APRIL 21.

Average values: 67.5(ms/cm).

The conductivity values of irrigation water are higher compared to rainfall water, indicating a higher concentration of dissolved salts in the irrigation water. This higher salt content in irrigation water increases its electrical conductivity. Conversely, rainfall water has a lower concentration of dissolved salts, resulting in lower electrical conductivity values.

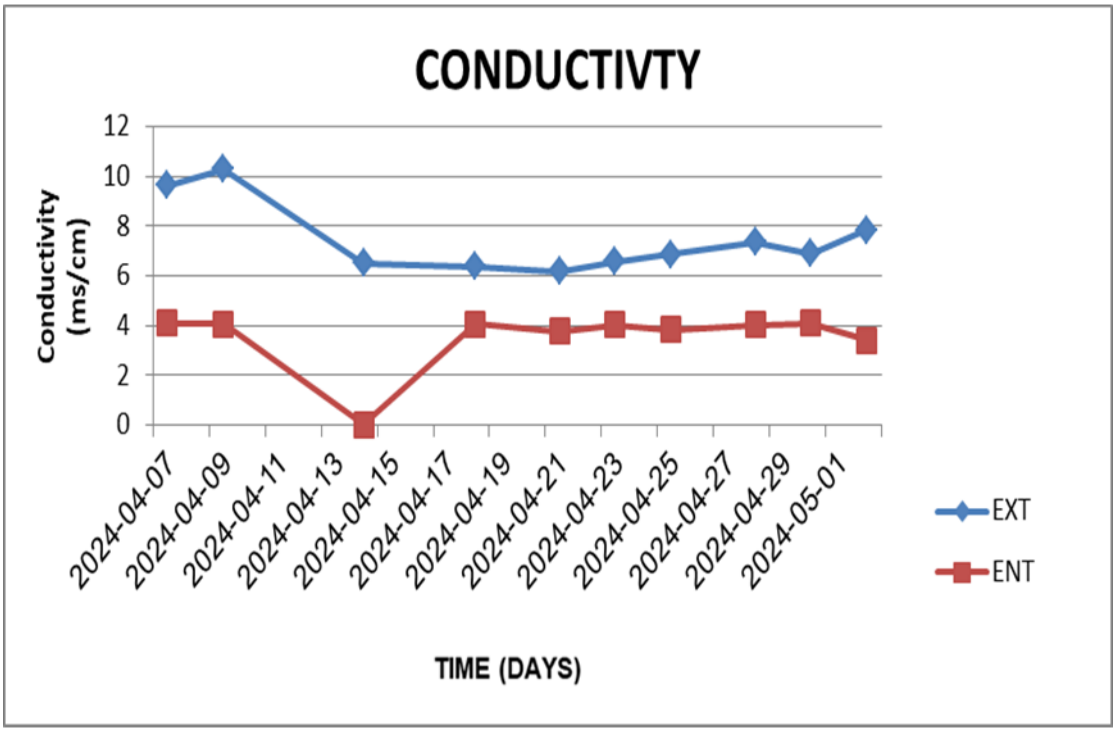


Figure36: Variation Curve of Electrical Conductivity in Irrigation Water and Agricultural Drainage Water Over Time (days).

3-Sample 7:

Graph representing the electrical conductivity of irrigation water and agricultural drainage over time (days) **(Figure 37)**.

❖ **irrigation water:**

Highest value: 4.078 (ms/cm) on APRIL 30.

Lowest value: 0.001 (ms/cm) on APRIL14 .

Average values: 3.5357 (ms/cm).

❖ **drainage water:**

Highest value: 9.606 (ms/cm) on May02.

Lowest value: 7.333(ms/cm) on APRIL 21.

Average values: 8.32 (ms/cm).

Agricultural drainage water shows higher electrical conductivity values compared to irrigation water, reflecting the influence of chemicals and fertilizers. This makes irrigation water more suitable for agricultural use, as it reduces the risk of soil salinization and maintains plant health.

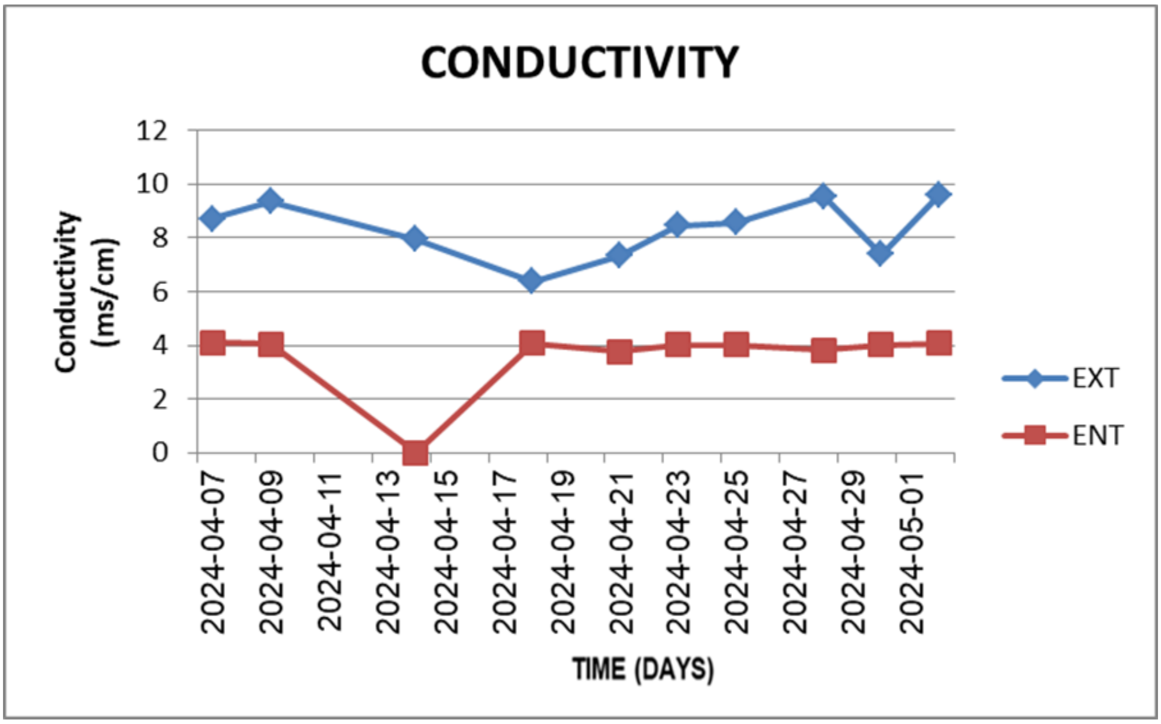


Figure 37: Variation Curve of Electrical Conductivity in Irrigation Water and Agricultural Drainage Water Over Time (days).

4-Sample 6:

Graph representing the electrical conductivity of irrigation water and agricultural drainage over time (days) **(Figure 38)**.

❖ **irrigation water:**

Highest value: 4.078 (ms/cm) on APRIL 30.

Lowest value: 0.001 (ms/cm) on APRIL14 .

Average values: 3.5357 (ms/cm).

❖ **drainage water:**

Highest value: 9.897 (ms/cm) on May02.

Lowest value: 6.624 (ms/cm) on APRIL 07.

Average values: 8.17 (ms/cm).

Agricultural drainage water contains a significantly higher concentration of dissolved salts compared to irrigation water, as reflected in the electrical conductivity values. This is due to the influence of chemicals and fertilizers used in agriculture.

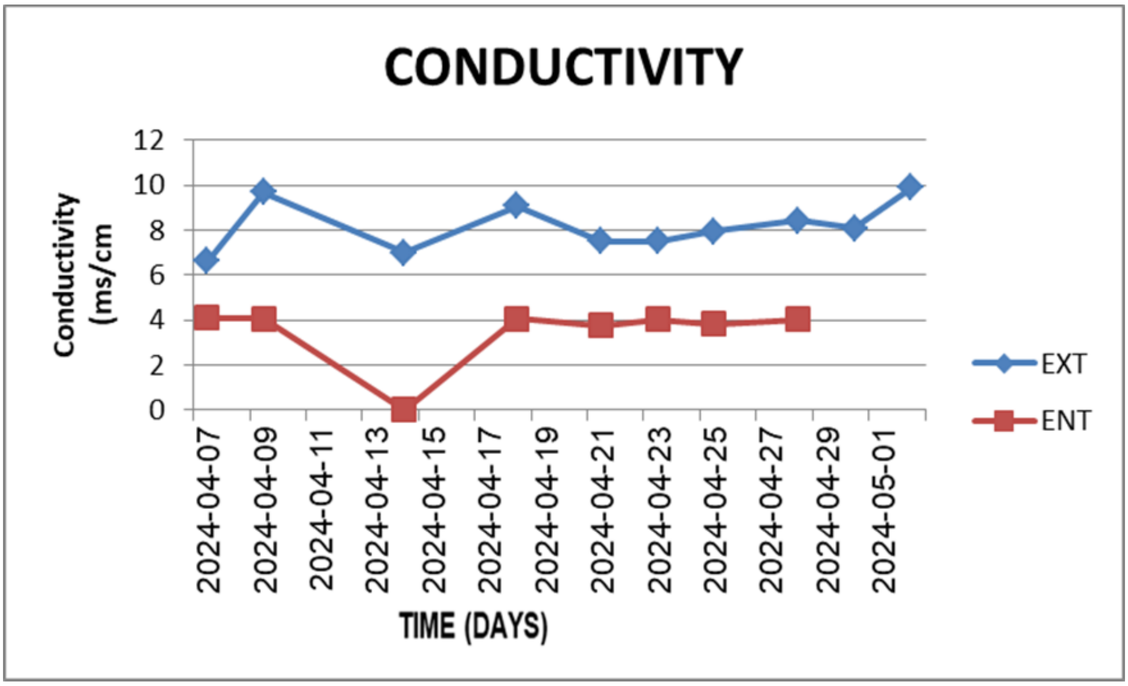


Figure 38: Variation Curve of Electrical Conductivity in Irrigation Water and Agricultural Drainage Water Over Time (days).

5-Sample 5:

Graph representing the electrical conductivity of irrigation water and agricultural drainage over time (days) **(Figure 39)**.

❖ **irrigation water:**

Highest value: 4.078 (ms/cm) on APRIL 30.

Lowest value: 0.001 (ms/cm) on APRIL14 .

Average values: 3.5357 (ms/cm).

❖ **drainage water:**

Highest value: 11.3 (ms/cm) on APRIL09.

Lowest value: 4.936 (ms/cm) on MAY 05.

Average values: 3.5357 (ms/cm).

The electrical conductivity of irrigation water appears lower compared to agricultural runoff water due to the lower salinity levels in irrigation water. This difference is attributed to the chemical composition of these waters. Irrigation water contains lower levels of salts, whereas agricultural runoff water contains higher levels of salts. This difference in chemical composition accounts for the variance in electrical conductivity between the two types of water.

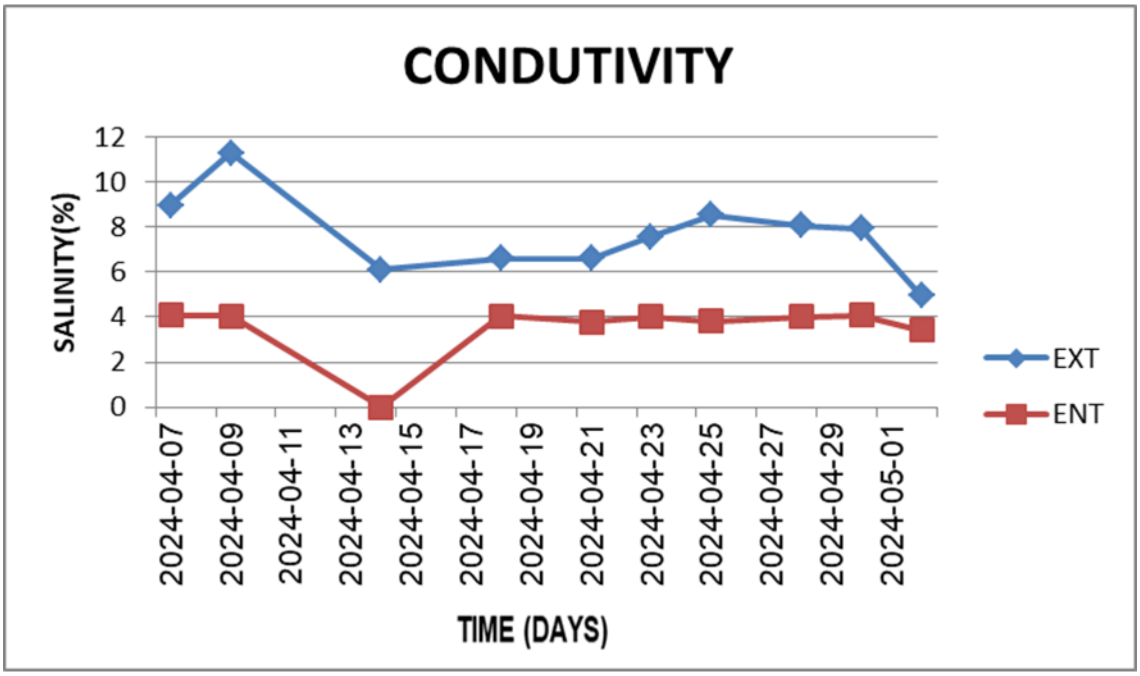


Figure39 : Variation Curve of Electrical Conductivity in Irrigation Water and Agricultural Drainage Water Over Time (days).

3-2-5- Temperature:

1-Sample 9:

Graph representing the temperature variations for irrigation water and agricultural drainage water Over Time(days) **(Figure 40).**

❖ **irrigation water:**

Highest value: 25.3 (C°) on APRIL 07.

Lowest value: 18.9 (C°) on APRIL14 .

Average values: 22.84 (C°).

❖ **drainage water:**

Highest value: 20.4 (C°) on APRIL09.

Lowest value: 25.8 (C°) on APRIL 18.

Average values: 22.7 (C°)**.**

Both types of water show similar temperature ranges, with slight variations in individual measurements. The temperature of agricultural drainage water is slightly lower compared to irrigation water. This is attributed to the time of sampling.

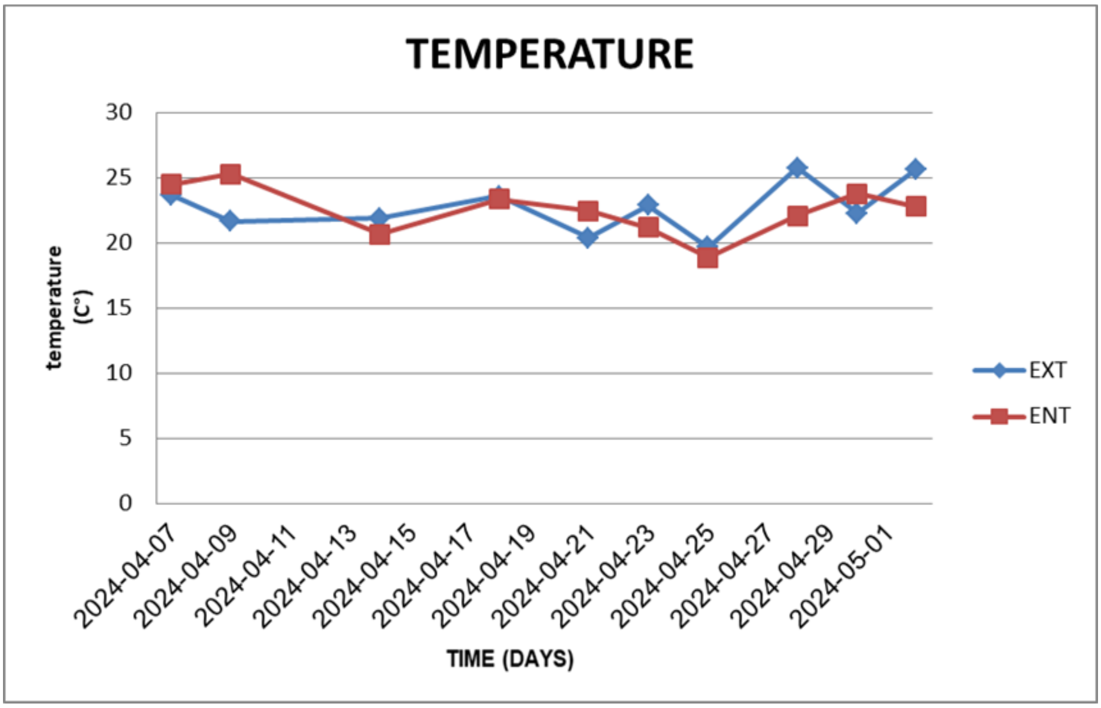


Figure 40: The Temperature Variation Curve in Irrigation Water and Agricultural Drainage Water Over Time(days).

2-Sample 8:

Graph representing the temperature variations for irrigation water and agricultural drainage water Over Time(days) **(Figure 41).**

❖ **irrigation water:**

Highest value: 25.3 (C°) on APRIL 07.

Lowest value: 18.9 (C°) on APRIL14 .

Average values: 22.84 (C°).

❖ **drainage water:**

Highest value: 20.4 (C°) on APRIL09.

Lowest value: 25.8 (C°) on APRIL 18.

Average values: 22.7 (C°)**.**

Both types of water show similar temperature ranges, with slight variations in individual measurements. The temperature of agricultural drainage water is slightly lower compared to irrigation water. This is attributed to the time of sampling.

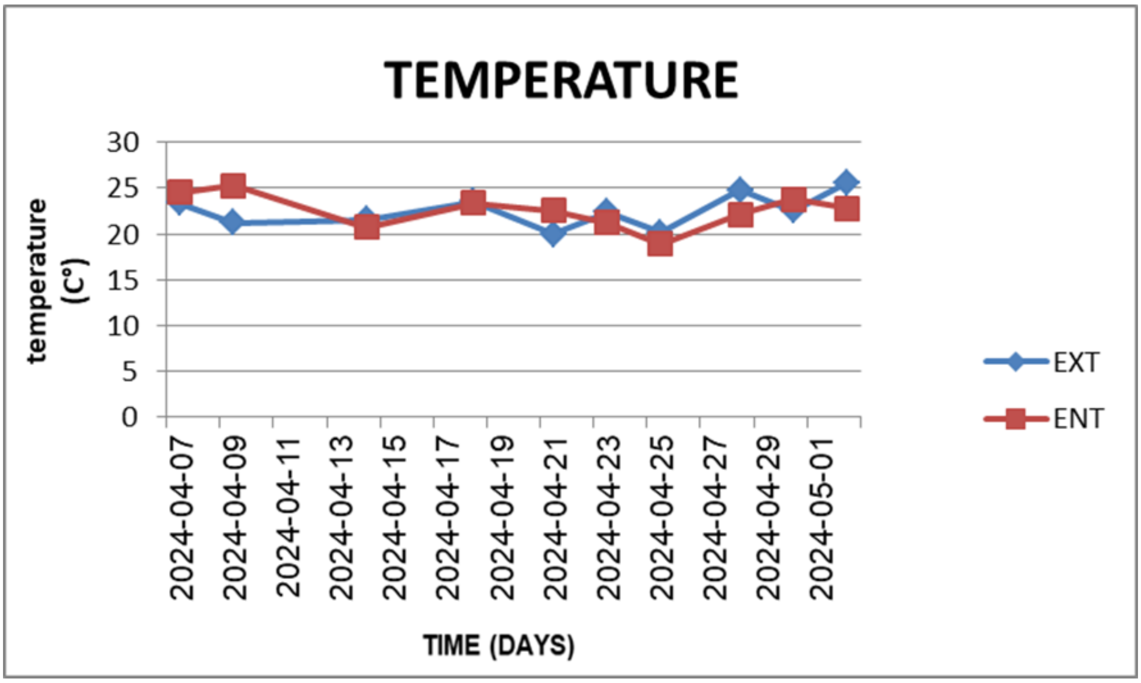


Figure 41: Temperature Variation Curve in Irrigation Water and Agricultural Drainage Water Over Time(days).

3-Sample 7:

Graph representing the temperature variations for irrigation water and agricultural drainage water Over Time(days) **(Figure 42)**.

❖ **irrigation water:**

Highest value: 25.3 (C°) on APRIL 07.

Lowest value: 18.9 (C°) on APRIL14 .

Average values: 22.84 (C°).

❖ **drainage water:**

Highest value: 20.4 (C°) on APRIL09.

Lowest value: 25.8 (C°) on APRIL 18.

Average values: 21.83 (C°)**.**

The temperature values for both agricultural drainage water and irrigation water are very close, with slight differences that can be attributed to environmental factors and storage conditions. Both types of water provide suitable temperatures for irrigation and healthy plant growth.

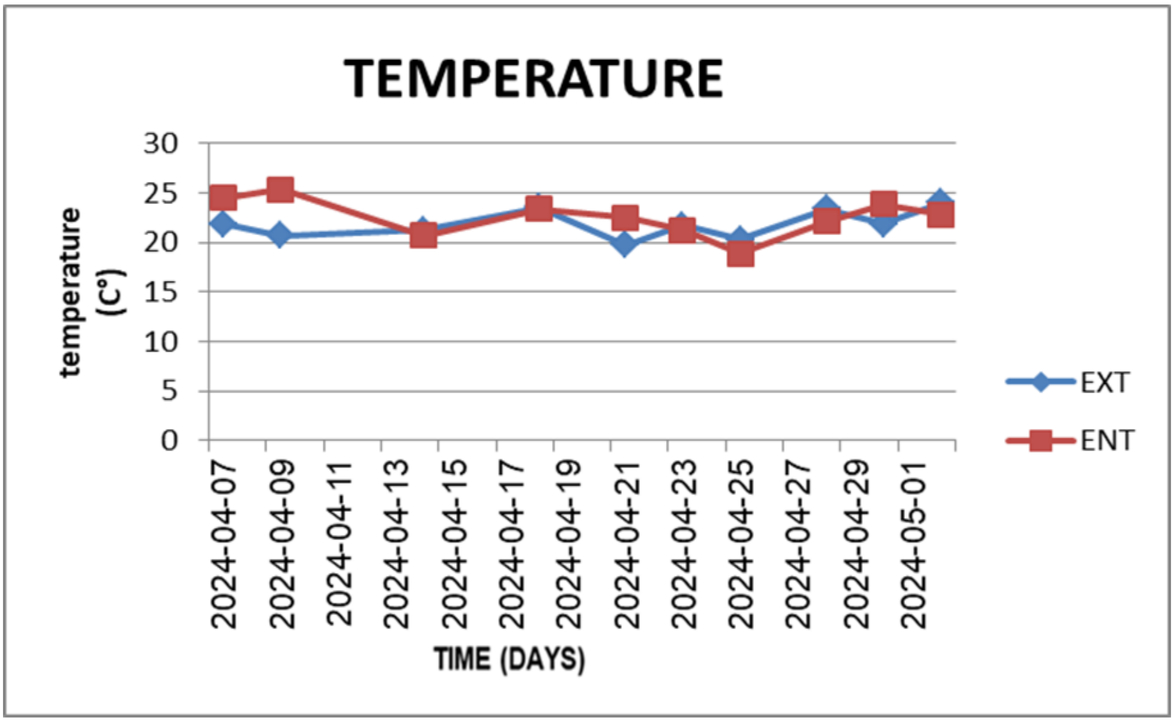


Figure 42: Temperature Variation Curve in Irrigation Water and Agricultural Drainage Water Over Time(days).

4-Sample 6:

Graph representing the temperature variations for irrigation water and agricultural drainage water Over Time(days) **(Figure 43).**

- **irrigation water:**

  Highest value: 25.3 (C°) on APRIL 07.

  Lowest value: 18.9 (C°) on APRIL14 .

  Average values: 22.84 (C°).

- **drainage water:**

  Highest value: 20.4 (C°) on APRIL09.

  Lowest value: 25.8 (C°) on APRIL 18.

  Average values: 21.95 (C°)**.**

The temperature values for agricultural drainage water and irrigation water are very close with slight differences. The average temperature for both is within the ideal range for plant growth**.**

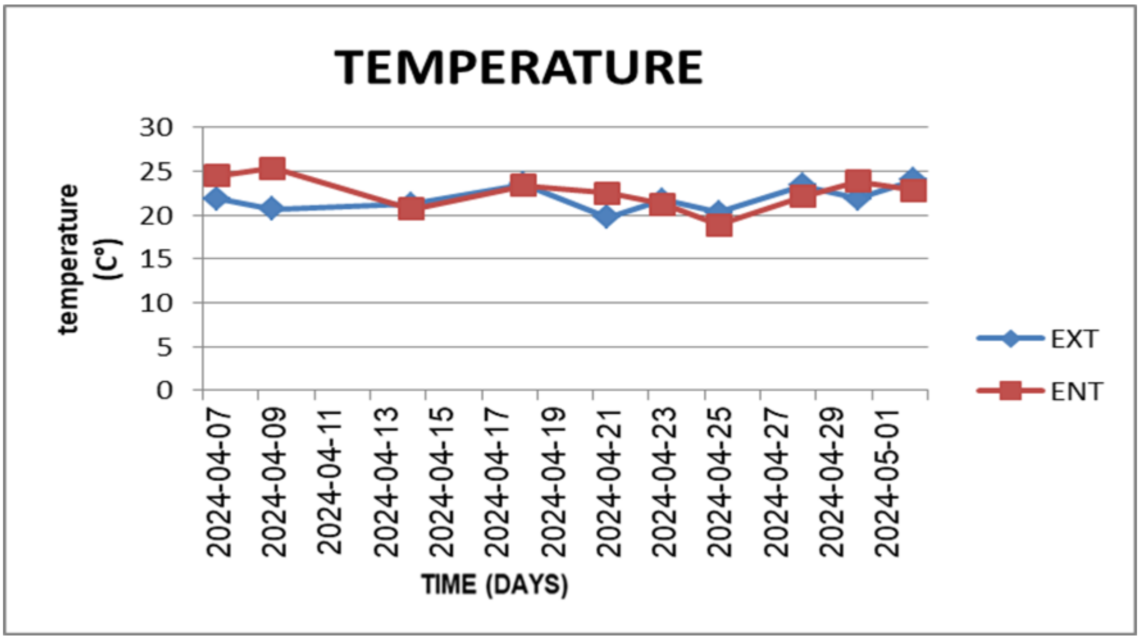


Figure 43: Temperature Variation Curve in Irrigation Water and Agricultural Drainage Water Over Time(days).

5- Sample5:

Graph representing the temperature variations for irrigation water and agricultural drainage water Over Time(days) **(Figure 44).**

❖ **irrigation water:**

Highest value: 25.3 (C°) on APRIL 07.

Lowest value: 18.9 (C°) on APRIL14 .

Average values: 22.84 (C°).

❖ **drainage water:**

Highest value: 26.2 (C°) on APRIL09.

Lowest value: 18 (C°) on APRIL 18.

Average values: 21.69 (C°)**.**

The temperature is similar between agricultural wastewater and irrigation water, while the existing variation is due to the water source and the environment in which it is found.

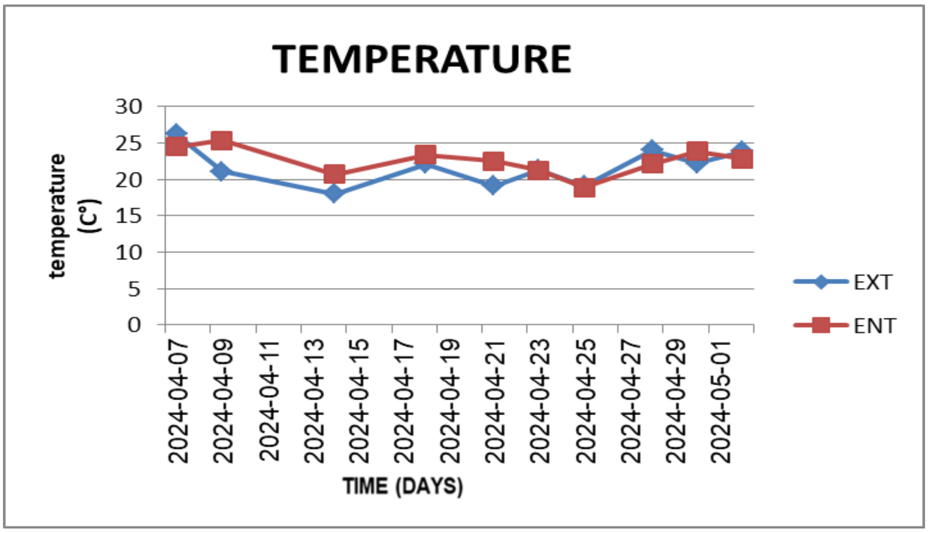


Figure44: Temperature Variation Curve in Irrigation Water and Agricultural Drainage Water Over Time(days).

III.3.3. The third stage:

3-3-1-pH:

graph representing the changes in pH of irrigation water and agricultural drainage water over time (days) **(Figure 45)**.

Saline Water (100%):

- **irrigation water:**

Highest value: 8.18 on MAY 23.

Lowest value:7.66 on JUNE 04.

Average values: 8.08.

- **drainage water:**

Highest value:8.1 on MAY21.

Lowest value:7.6 on MAY 09.

Average values:7.79.

Mixed Water (tap water50%, saline 50%):

- **irrigation water:**

  Highest value: 8.29on MAY 21.

  Lowest value:7.31on MAY 26.

  Average values: 7.91.

- **drainage water:**

  Highest value: 8.275on MAY30.

  Lowest value: 7.7 on MAY 07.

  Average values:7.95.

  Tap water 0%:

- **irrigation water:**

  Highest value: 8.19 on MAY 05.

  Lowest value: 6.98 on MAY 28. Average values: 7.76.

- **drainage water:**

  Highest value:8.35 on MAY09.

  Lowest value:7.49on MAY 19.

  Average values:8.02.

It has been observed that the average salty **water**, pH of irrigation water (8.08) is higher than the average pH of agricultural drainage water (7.84). This difference can be considered within a close range, but it reflects the tendency of irrigation water to be more alkaline. This can affect the uses of this water in agriculture, as alkaline water may be more suitable for some plants and less suitable for others. **Mixed water,** irrigation water is slightly alkaline with an average of 7.91, while agricultural drainage water is also around 8, indicating that it is generally alkaline. Irrigation water is slightly more alkaline than drainage water. It can affect plants and soil in different ways. **Tap water**, I consider irrigation water to be slightly alkaline with an average of 7.76, slightly lower than agricultural drainage water with an average of 8.02, so it's also considered alkaline. Irrigation water can affect soil properties and nutrient elements in the soil.

The effects of alkalinity on soil and plants depend on the level of alkalinity. High alkalinity can lead to nutrient fixation and make them less available to plants, as well as change the soil's condition and its permeability. Most results indicate that irrigation water is often higher than agricultural drainage water **(ZAIZ , 2024)**.

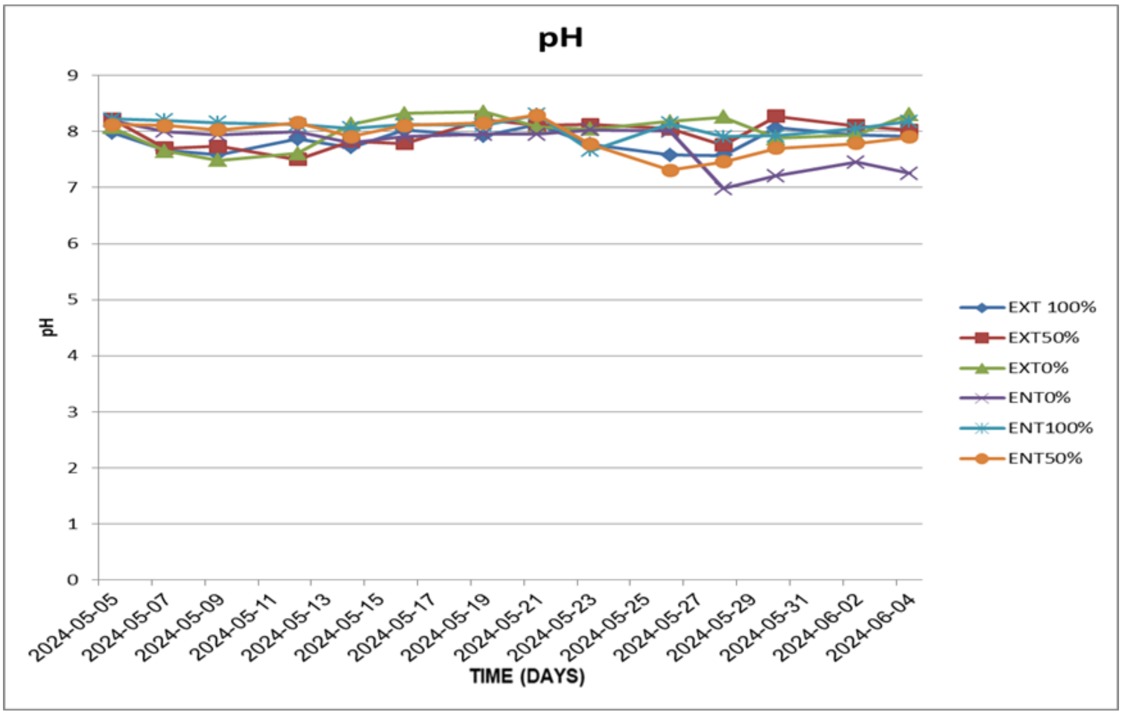


Figure 45: pH Variation Curve of Irrigation Water and Agricultural Drainage Water Over Time(days).

3-3-2-TDS:

graph representing the changes in Total dissolved salts in irrigation water and agricultural drainage water over time (days) **(Figure 46)**.

Saline Water(100%):

❖ **irrigation water:**

Highest value:2.558 (PPT) on MAY16.

Lowest value: 1.36(PPT) on MAY12.

Average values:1.862 (PPT).

❖ **drainage water:**

Highest value: 5.905 (PPT) on MAY 05.

Lowest value: 2.903 (PPT) on MAY 23.

Average values: 4.266 (PPT).

Mixed Water(tap water50%, saline 50%):

- **irrigation water:**

  Highest value: 2.252(PPT) on JUNE02.

  Lowest value: 1.448(PPT) on MAY05 .

  Average values: 1.85(PPT).

- **drainage water:**

  Highest value: 6.2635 (PPT) on JUNE 02.

  Lowest value: 3.668 (PPT) on MAY 05.

  Average values:4.93 (PPT).

  Tap water 0%:

- **irrigation water:**

  Highest value: 2.087(PPT) on MAY16.

  Lowest value: 1.308(PPT) on MAY12.

  Average values:1.933 (PPT).

- **drainage water:**

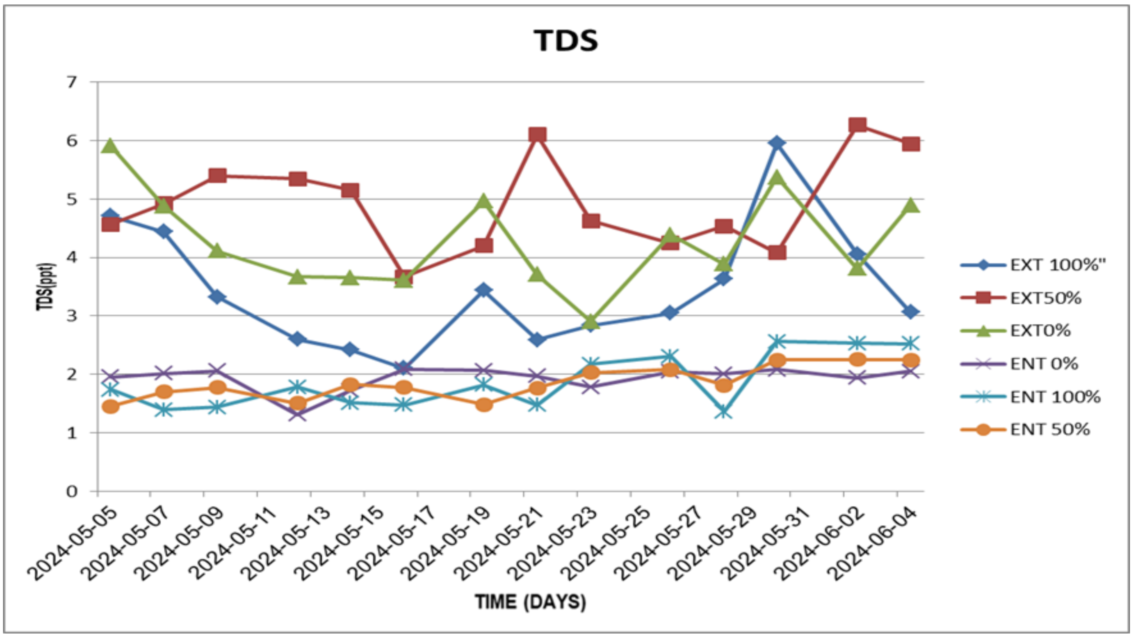
  Highest value: 5.905(PPT) on MAY 05.

  Lowest value:4.964 (PPT) on MAY 19.

  Average values:4.266 (PPT).

It has been observed that the average . **Saline Water**, total dissolved salt content in irrigation water (1.883 PPT) is lower than in agricultural drainage water (4.334 PPT), and this significant difference lies in the accumulation of dissolved salts in the soil, leading to soil degradation, reduced quality, and its impact on plants .**Mixed water** ,the soluble salts in agricultural drainage water have an average concentration of (4.93), which is higher than the average concentration of soluble salts in irrigation water (1.85). This is due to the leakage of organic materials from the soil, and the high concentration of soluble salts can affect plants and soil. **Tap water**, The average concentration of dissolved salts in agricultural drainage water (4.212 PPT) is significantly higher than the average concentration in irrigation water (1.967 PPT). This difference can be attributed to the characteristics of agricultural drainage water.

Irrigation water often has a lower concentration of dissolved salts compared to agricultural drainage water. This is due to evaporation and the continuous accumulation of salts in the soil.



Figure`.46: Variation Curve of Total Dissolved Salts in Irrigation Water and Agricultural Drainage Water Over Time(days).

3-3-3-Salinity:

graph representing the changes in salinity of irrigation water and agricultural drainage water over time (days) **(Figure 47)**.

Saline Water(100%):

❖ **irrigation water:**

Highest value:10 (%) on MAY 30.

Lowest value:6.8 (%) on MAY 05 .

Average values:7.28 (%).

❖ **drainage water:**

Highest value: 23.1(%) on MAY05.

Lowest value: 11.4(%) on MAY 23.

Average values:16.7 (%).

Mixed Water(tap water50%, saline 50%):

- **irrigation water:**

    Highest value:8.8 (%) on JUNE 02.

    Lowest value:5.7 (%) on MAY 05 .

    Average values:7.24 (%).

- **drainage water:**

    Highest value: 11.49 (%) on APRIL09.

    Lowest value: 24.45(%) on MARCH 02.

    Average values: 18.62(%)

    Tap water 0%:

- **irrigation water:**

    Highest value: 8.1 (%) on MAY 09.

    Lowest value:5.1 (%) on MAY 12 .

    Average values:7.56 (%).

- **drainage water:**

    Highest value: 23.1(%) on MAY 05.

    Lowest value:11.4 (%) on MAY 23.

    Average values: 16.7(%).

Saline Water ,The average salinity of irrigation water is about(7.264%), while the average salinity of agricultural drainage water is about (16.364%), indicating that agricultural drainage water has a higher concentration than irrigation water due to its chemical composition**. Mixed Water** , It is observed that the average salinity of **agricultural drainage water** (18.62%) is significantly higher than that of irrigation water (7.24%). This is due to the purity of the irrigation water and the lack of salt accumulation in it, whereas the agricultural drainage water contains higher concentrations of salts due to the continuous accumulation of salts in the soil from irrigation and the use of organic fertilizers. **Tap water** , We observe that the average salinity of agricultural drainage water (16.7%) is significantly higher than that of irrigation water (6.43%). This is due to the interaction of fertilizers with the water during irrigation. Salts dissolve from the soil and accumulate in the agricultural drainage water. Soil salinity increases in the sample with rising temperatures, which is attributed to evaporation. The increased water content in the soil can lead to higher soil salinity due to the use of highly saline water(Ahmed F. Saad , 2024).

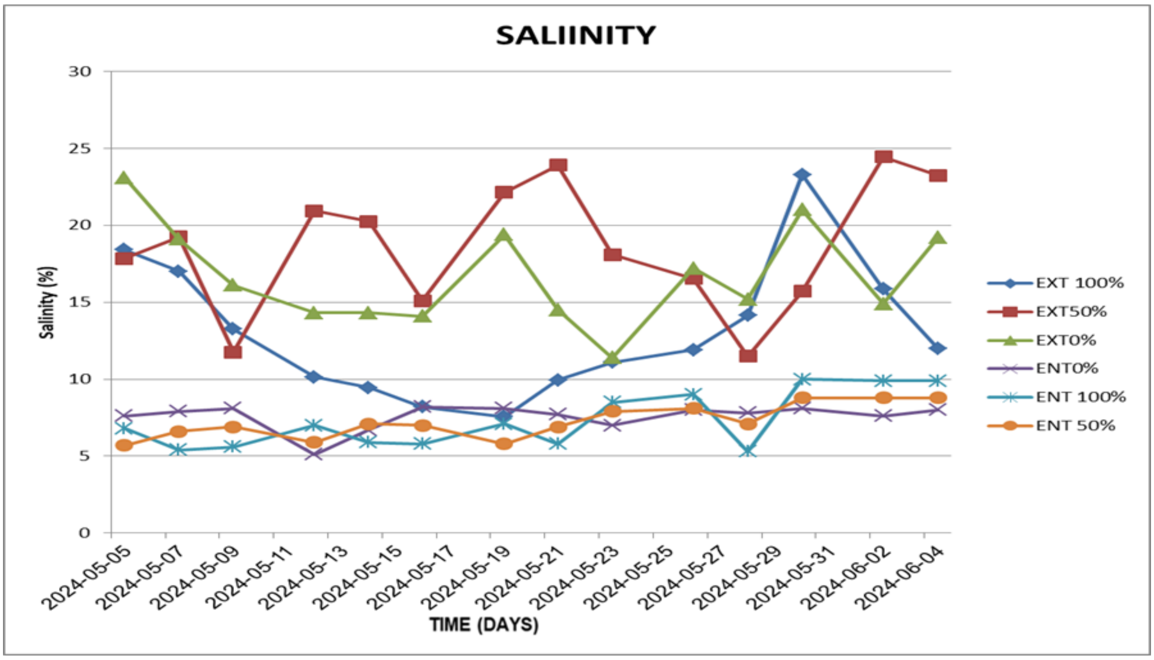


Figure 47: Salinity Variation of Irrigation Water and Agricultural Drainage Water Over Time(days).

3-3-4-Conductivity:

graph representing the electrical conductivity of irrigation water and agricultural drainage over time (days) **(Figure 48)**.

Saline Water(100%):

- ❖ **irrigation water:**

Highest value:5.111 (ms/cm) on MAY30.

Lowest value: 2.387 (ms/cm) on MAY 09 .

Average values: 3.69 (ms/cm).

- ❖ **drainage water:**

Highest value: 12.0 (ms/cm) on MAY 19.

Lowest value: 3.9(ms/cm) on MAY 05.

Average values: 8.52 (ms/cm).

Mixed Water(tap water50%, saline 50%):

- **irrigation water:**

  Highest value: 4.499 (ms/cm) on JUNE 02.

  Lowest value:2.913 (ms/cm) on MAY 05 .

  Average values:3.70 (ms/cm).

- **drainage water:**

  Highest value: 11.90 (ms/cm) on JUNE 04.

  Lowest value: 7.71 (ms/cm) on MAY 16.

  Average values:9.81 (ms/cm).

  Tap water 0%:

- **irrigation water:**

  Highest value: 4.515 (ms/cm) on APRIL 30.

  Lowest value:2.616 (ms/cm) on APRIL12 .

  Average values:3.91 (ms/cm).

- **drainage water:**

  Highest value:11.8 (ms/cm) on APRIL05.

  Lowest value:5.809 (ms/cm) on APRIL 23.

  Average values: 8.52(ms/cm).

Saline Water, it was noted that the average of agricultural drainage water at (3.69 ms/cm) is less than the average of agricultural drainage water at (8.52 ms/cm) and this is due to the concentration of salts and minerals in the water. **Mixed Water**, t was noted that the average agricultural drainage water (3.70) is higher than irrigation water by an average of (9.81), and this is due to agricultural drainage water containing much higher concentrations of salts and minerals. **Tap water**, It has been noticed that the average electrical conductivity of irrigation water (3.91) is lower than the average electrical conductivity of agricultural drainage water (8.52). This difference is due to the variation in salt and mineral concentrations between the two types of water .

The electrical conductivity of water increases with higher concentrations of salts and minerals, as well as with rising temperatures. Therefore, the electrical conductivity of agricultural drainage water is higher due to its higher concentrations of salts and minerals resulting from fertilizer use, and this conductivity also increases with higher temperatures.

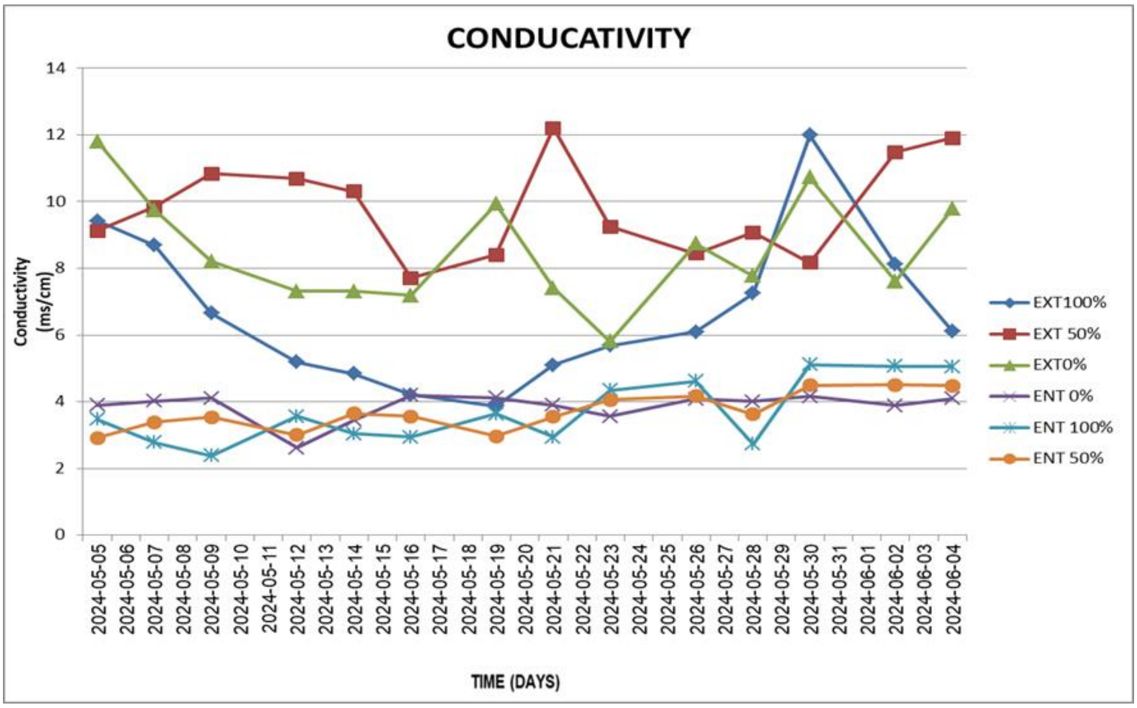


Figure 48: Variation Curve of Electrical Conductivity in Irrigation Water and Agricultural Drainage Water Over Time (days).

3-3-5-Temperature:

graph representing the temperature variations for irrigation water and agricultural drainage water Over Time(days) **(Figure 49).**

Saline Water (100%):

❖ **irrigation water:**

Highest value: 30.7 on APRIL30 (C°).

Lowest value: 20.4on APRIL09(C°).

Average values: 26.39(C°).

❖ **drainage water:**

Highest value: 30.9 (C°) on MAY 23.

Lowest value: 24.5(C°) on MAY26.

Average values:26.15 (C°)**.**

Mixed Water(tap water50%, saline 50%):

- **irrigation water:**

Highest value: 30.87 (C°) on MAY 30.

Lowest value:22 on(C°) on MAY 09 .

Average values: 26.66(C°).

- **drainage water:**

Highest value:30.60 (C°) on JUNE 02.

Lowest value: (C°) on MAY 09.

Average values:26.99 (C°)**.**

Tap water 0%:

- **irrigation water:**

Highest value: 29.1 (C°) on MAY19.

Lowest value: 24.3 (C°)on MAY05 .

Average values: 22.78 (C°).

- **drainage water:**

Highest value:28.3(C°) on JUNE 02.

Lowest value: 22.9(C°) on MAY 09.

Average values: 25.92(C°)**.**

Saline Water, The analysis shows that irrigation water tends to be slightly warmer (around 26.82 C°) compared to agricultural drainage water (around 25.92 C°) on average. This difference can be influenced by several factors such as the water source, environmental conditions, and timing of water use in agricultural practices. **Mixed Water ,** It has been observed that the average temperature of irrigation water (about 26.66 C°) is slightly higher compared to the average temperature of agricultural drainage water (about 26.99C°). This slight difference could be due to various factors, such as differences in the water source, how it is used for irrigation, and the effects of the surrounding environment. **Tap water ,** It has been observed that the average temperature of irrigation water (about 22.78 C°) is slightly higher compared to the average temperature of agricultural drainage water (about 25.97 C°). This slight difference could be due to multiple factors.

The temperature plays a vital role in the changes of the elements, the higher the temperature, the faster the evaporation, resulting in a concentration of dissolved elements in the water.

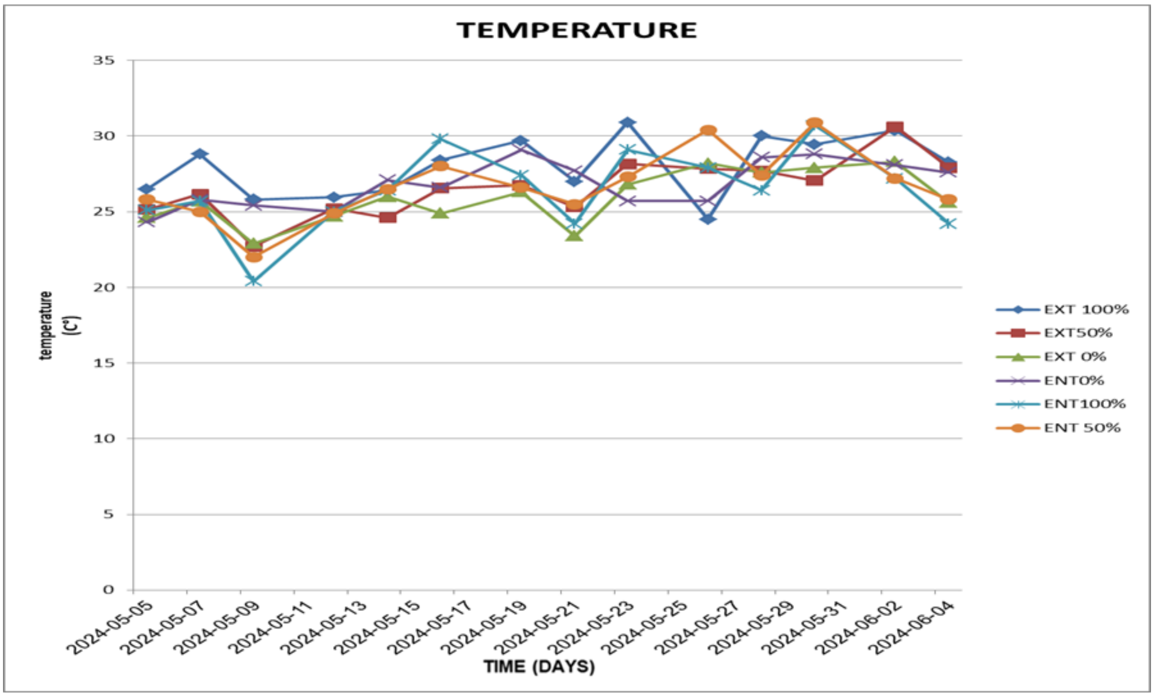


Figure 49 : Temperature Variation Curve in Irrigation Water and Agricultural Drainage Water Over Time(days).

III-4 The discussion of results

The soil Washing process involves the transport of solids or minerals present in the soil by water. The more porous the soil, the easier it is for chemicals to pass through, increasing the likelihood of excessive leaching **(CPEO ,2024)** . In the first and second stages, there was no significant change in salinity, indicating that tap water is good for irrigation. Additionally, in the second stage, samples (1, 2, 3, 4) were lost due to two possible reasons:

1- Change in the environment where the seedlings were planted.

2-Disturbed climate (winds and temperatures).

In the third stage, when saline water was used, the agricultural drainage water became more concentrated with salts compared to the irrigation water. This is because salts do not remain in the soil but move from the soil to the drainage water. In sample 7, the phenomenon of water rising was observed due to two hypotheses:

1-Salts clogged the pores between the particles.

2-The deposition of salts among soil particles.

Saline water acts as a catalyst for some types of leafy plants that can be grown in a saline environment, as observed by the increase in the covered area of plants like the one used in our study (purslane). In contrast, for beet plants, mixed water had a more effective result than saline water, which affected plant growth, while tap water was suitable for its growth.

General Conclusion

General conclusion

In this thesis, we studied soil degradation and infrastructure due to the random disposal of saline water from desalination plants. We worked on beet seeds by planting them in compost-enriched soil in germination trays as phase 1. After germination, the seedlings were transferred to tanks filled with sandy soil mixed with industrial organic fertilizer as phase 2. The irrigation system was switched from sprinkler irrigation to drip irrigation and sprayed with three types of water: saline water, mixed water, and tap water. For each phase, physical and chemical analyses were performed on both irrigation and agricultural drainage water, and comparisons were made between the analyses of each type of water before and after irrigation.

The analysis results obtained indicate that in the first and second phases, the water quality ranged from good to medium according to the applicable standards. In the third phase, the analysis confirmed that salinity is affected by ions that have a strong relationship with electrical conductivity. Dissolved salts precipitate in agricultural drainage water, and their concentration varies according to soil characteristics and the type of water used in irrigation. Agricultural drainage water contains varying levels of salinity, and the main sources of these salts are the components present in the irrigation water. The differences between irrigation water and agricultural drainage water lie in the accumulation of salts and filtration under certain conditions.

recommendations:

-Sustainable improvements for agricultural productivity in saline soils.

-Encourage farmers to use saline water for irrigating salt-tolerant crops with drip irrigation systems to mitigate the impact of salinity on crop yield, reduce surface evaporation, and enhance water flow to the subsoil.

-Develop a network to monitor risks associated with soil salinity.

-Intensify studies on water desalination and the treatment of saline solutions.

-Open opportunities for researchers in the field.

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APPENDIX

APPENDIX1: Results of water analysis before soaking the seeds**.**

Analysis / DAY	PH	TDS (ppt)	SALITY(%)	Conductivity(μs /cm)	temperature(C°)
10-03-2024	8.26	7.37	0	16.35	23.8

APPENDIX2: Results of water analysis after soaking the seeds**.**

Analysis DAY	PH	TDS(ppt)	SALITY(%)	Conductivity(ms/cm)	temperature(C°)
11-03-2024	6.9	1.34	5.2	2.561	19.2

APPENDIX 3: Results of pH Measurement for Irrigation Water and Agricultural Drainage Water.

Analysis	PH	
TIME (DAYS)	Water Irrigation Analysis	Overflow Drainage for Water
14-03-2024	7.97	6.03
16-03-2024	7.63	6.08
17-03-2024	7.5	6.27
18-03-2024	7.44	6.25
19-03-2024	7.69	6.57
20-03-2024	7.5	7
21-03-2024	7.6	6.89
24-03-2024	7.7	7.38
25-03-2024	7.86	7.45
26-03-2024	7.98	7.3
27-03-2024	7.95	7.2

APPENDIX 4: Results of Salinity Measurement for Irrigation Water and Agricultural Drainage Water.

Analysis	Salinity(%)	
TIME (DAYS)	Water Irrigation Analysis	Overflow Drainage for Water
14-03-2024	4.3	0
16-03-2024	7.9	8.3
17-03-2024	5.7	16.4
18-03-2024	8	8.9
19-03-2024	7.3	18.6
20-03-2024	5.6	9.2
21-03-2024	5.8	10.4
24-03-2024	7.9	10.1
25-03-2024	7.9	18.8
26-03-2024	7.9	13.1
27-03-2024	8.1	12

APPENDIX 3: Results of Total dissolved salts Measurement for Irrigation Water and Agricultural Drainage Water.

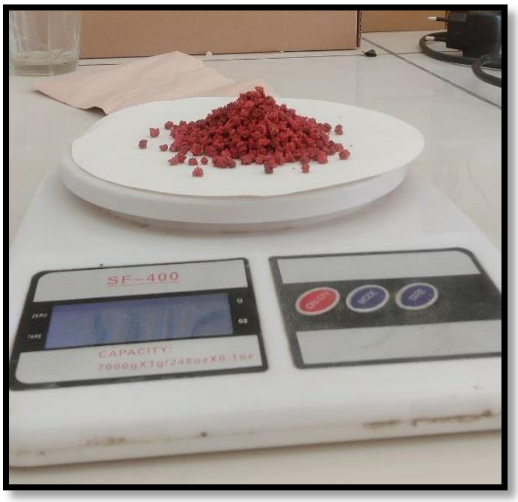
Analysis	TDS(ppt)	
TIME (DAYS)	Water Irrigation Analysis	Overflow Drainage for Water
14-03-2024	1.089	0
16-03-2024	2.017	2.107
17-03-2024	1.455	4.17
18-03-2024	2.053	2.263
19-03-2024	1.863	4.742
20-03-2024	1.427	2.358
21-03-2024	1.464	2.655
24-03-2024	2.015	2.57
25-03-2024	2.016	4.8
26-03-2024	2.025	3.249
27-03-2024	2.067	3.203

APPENDIX 4: Results of conductivity Measurement for Irrigation Water and Agricultural Drainage Water.

Analysis	Conductivity (ms/cm)	
TIME (DAYS)	Water Irrigation Analysis	Overflow Drainage for Water
14-03-2024	2.175	0.175
16-03-2024	4.016	4.205
17-03-2024	2.916	8.32
18-03-2024	4.107	4.52
19-03-2024	3.73	9.484
20-03-2024	2.857	4.7
21-03-2024	2.923	5.304
24-03-2024	4.023	5.13
25-03-2024	4.027	9.601
26-03-2024	4.047	6.177
27-03-2024	4.126	6.112

APPENDIX 5: Results of temperature Measurement for Irrigation Water and Agricultural Drainage Water.

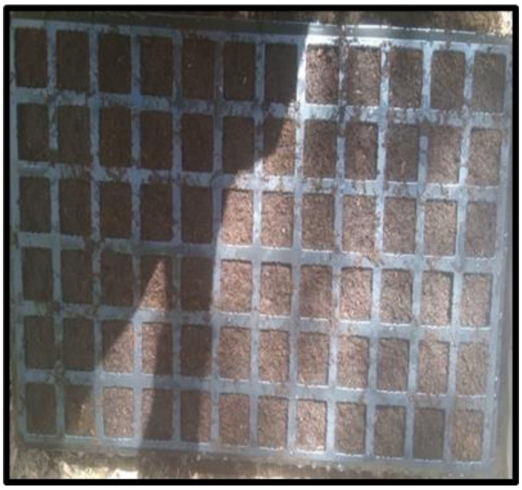
Analysis	temperature (C°)	
TIME (DAYS)	Water Irrigation	Overflow Drainage
14-03-2024	20.4	30.3
16-03-2024	20.6	33
17-03-2024	21	30.9
18-03-2024	21.7	28.1
19-03-2024	22.3	27.5
20-03-2024	22.6	29.3
21-03-2024	22.1	27.7
24-03-2024	22.3	25.8
25-03-2024	22.9	26.1
26-03-2024	22.4	28.3
27-03-2024	21.7	24



Appendix1: red beet seeds

Appendix 2 : soaking seeds in water

Appendix 3: beet seeds after soaking distille



Appendix4 : beet cultivation

Appendix 5 : After 5 days from planting

Appendix 6 : After 15 days from planting

The second stage:

POST:09

APPENDIX6: Results of Agricultural Drainage Water Variables.

Analysis / DAYS	PH	TDS(ppt)	Salinity(%)	Conductivity(ms/cm)	temperature (C°)
07-04-2024	7.74	3.906	15.3	7.826	23.7
09-04-2024	7.43	4.687	18.3	9.363	21.7
14-04-2024	7.36	4.152	16.3	8.303	21.9
18-04-2024	7.81	3.49	13.7	6.983	23.6
21-04-2024	7.8	3.662	14.3	7.334	20.4
23-04-2024	7.54	3.922	15.3	7.85	22.9
25-04-2024	7.77	3.923	15.3	7.867	19.7
28-04-2024	7.7	4.186	16.4	8.383	25.8
30-04-2024	7.68	3.65	14.3	7.3	22.3
02-05-2024	8.02	4.167	16.3	8.336	25.7

POST:08

APPENDIX7: Results of Agricultural Drainage Water Variables.

Analysis / DAYS	PH	TDS(ppt)	Salinity(%)	Conductivity(ms/cm)	temperature (C°)
07-04-2024	7.72	4.818	18.5	9.635	23.4
09-04-2024	7.42	5.136	20.1	10.29	21.2
14-04-2024	7.44	3.256	12.7	6.508	21.5
18-04-2024	7.82	3.189	12.5	6.378	23.5
21-04-2024	8.26	3.096	12.1	6.194	20
23-04-2024	7.69	3.292	12.9	6.581	22.4
25-04-2024	8.15	3.436	13.4	6.87	20.1
28-04-2024	7.77	3.679	14.4	7.355	24.8
30-04-2024	7.78	3.45	13.5	6.905	22.5
02-05-2024	8.02	6.506	15.4	7.836	25.6

POST:07

APPENDIX8: Results of Agricultural Drainage Water Variables.

Analysis DAYS	PH	TDS(ppt)	Salinity(%)	Conductivity(ms/cm)	temperature (C°)
07-04-2024	7.64	4.36	17.1	8.716	21.9
09-04-2024	7.43	4.687	18.3	9.363	20.7
14-04-2024	7.37	3.962	15.5	7.934	21.2
18-04-2024	7.77	3.189	12.5	6.378	23.5
21-04-2024	7.82	3.669	14.4	7.333	19.7
23-04-2024	7.73	4.23	16.6	8.457	21.7
25-04-2024	8	4.287	16.8	8.573	20.3
28-04-2024	7.78	3.957	15.5	9.543	23.4
30-04-2024	7.62	3.692	14.5	7.385	21.9
02-05-2024	8.02	6.506	18.8	9.606	24

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APPENDIX9: Results of Agricultural Drainage Water Variables.

Analysis DAYS	PH	TDS(ppt)	Salinity(%)	Conductivity(ms/cm)	temperature (C°)
07-04-2024	7.72	3.309	12.9	6.624	22.3
09-04-2024	6.37	4.847	19	9.689	19.8
14-04-2024	7.32	3.493	13.7	6.986	21.7
18-04-2024	7.8	4.524	17.7	9.054	22.4
21-04-2024	7.7	3.757	14.7	7.513	18.7
23-04-2024	7.53	3.751	14.7	7.503	21.4
25-04-2024	7.97	3.984	15.7	7.96	19.9
28-04-2024	7.69	4.214	16.5	8.428	23.6
30-04-2024	7.53	4.034	15.8	8.065	21.9
02-05-2024	7.96	4.946	19.3	9.897	23.8

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APPENDIX10: Results of Agricultural Drainage Water Variables.

Analysis DAYS	PH	TDS(ppt)	Salinity(%)	Conductivity(ms/cm)	temperature (C°)
07-05-2024	7.87	4.482	17.5	8.955	26.2
09-04-2024	7.44	5.636	22	11.3	21.1
14-04-2024	7.44	3.054	11.9	6.105	18
18-04-2024	7.89	3.307	12.9	6.618	22.1
21-04-2024	7.74	3.307	12.9	6.613	19.1
23-04-2024	7.52	3.782	14.8	7.568	21.3
25-04-2024	7.81	4.275	16.7	8.548	19.1
28-04-2024	7.72	4.045	15.8	8.081	24
30-04-2024	7.85	3.992	15.6	7.93	22.2
02-05-2024	7.96	2.467	9.7	4.936	23.8

APPENDIX11: Results of Irrigation Water Variables

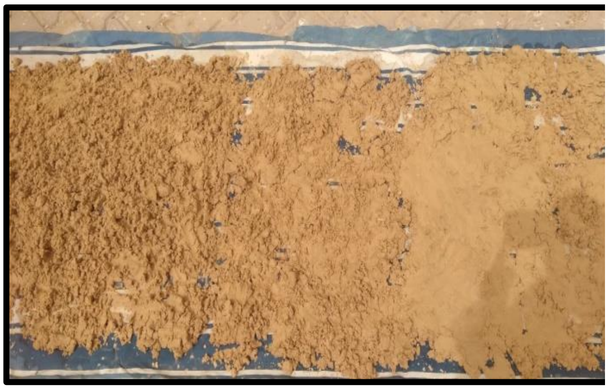
Analysis / DAY	PH	TDS(ppt)	Salinity(%)	Conductivity (ms/cm)	temperature (C°)
31-03-2024	7.8	1.147	4.5	2.284	23.7
01-04-2024	7.99	1.973	7.7	3.951	24.8
02-04-2024	7.97	1.577	6.2	3.193	25
03-04-2024	7.91	1.029	4	2.058	23.7
04-04-2024	7.87	2	7.6	4.019	24.3
07-04-2024	7.88	2.046	8	4.088	24.5
09-04-2024	7.72	2.025	7.9	4.052	25.3
14-04-2024	8.35	0	0	0.001	20.7
18-04-2024	8.04	2.031	8	4.063	23.4
21-04-2024	8.07	1.878	7.3	3.769	22.5
23-04-2024	7.94	2.004	7.8	4.028	21.2
25-04-2024	7.95	1.91	7.5	3.831	18.9
28-04-2024	8.07	2.015	7.9	4.03	22.1
30-04-2024	8.05	2.045	8	4.078	23.8
02-05-2024	8.05	1.726	6.7	3.417	22.8

APPENDIX12 : soil wash analysis.

Analysis / DAY	PH	TDS(ppm)	SALITY(%)	Conductivity(μs/cm)	temperature(C°)
28-03-2024	8.02	0.004	0	0.008	22.2

APPENDIX13: analysis values for soil Wash.

Analysis & sample	PH	SALITY(%)	TDS(ppt)	Conductivity (ms/cm)	temperature (C°)
Sample1	7.41	3.4	867.5	1.737	19.7
	7.66	2	522.9	1.046	20.2
	7.57	2.5	62	1.25	20.8
Sample2	7.68	2.2	567.7	1.133	20
	7.68	1.3	336.6	674.6	20.7
	7.58	1.4	365.2	734	22.3
Sample3	7.67	1.1	289.5	580.4	19
	7.69	2.3	578.2	1.156	22.1
	7.62	1.5	378.6	758	22.1
Sample4	7.64	1.4	363.8	727.2	21
	7.77	1	247.2	494.1	21.8
	7.73	1.2	247.2	634	22.3
Sample5	7.77	2.3	577.6	1.153	19.2
	7.78	1.1	290.5	578.5	19.6
	7.79	1.4	348	692	21.1
Sample6	7.97	0.8	209.7	417.7	20.3
	7.98	2	516.3	1.035	20.6
	7.9	1.3	322.6	645	20.8
Sample7	7.78	1.6	396.2	793	19.8
	7.94	1.7	440.4	881.1	19.7
	7.88	2.5	642.6	1.286	22.4
Sample8	7.87	0.9	230.6	460.2	20.1
	7.9	1.6	409.3	817.7	20
	8.22	1	264.9	529.6	21.7
Sample9	7.9	1.7	443.2	884.5	20.7
	7.9	2.2	563.3	1.123	20
	7.98	1.6	396.1	790.1	21.4
Sample10	7.86	2.1	540	1.08	20
	7.96	1.8	462.1	928.5	19.2
	8.1	1.6	401.2	802	21.6
Sample11	7.85	2.7	693.8	1.387	19.1
	7.97	3	236.1	469.2	20.7
	7.91	0.9	757.3	1.514	23
Sample12	8.43	0.8	216.7	433.1	22.8
	7.96	0.9	2.439	485.4	14.4
	7.86	1.7	454.6	907.6	16.4



Appendix 7: how to wash the sand.

Appendx8: drying the sand.

Appendx9 : the used fertilizer

Appendx10 : mixture of soil and fertilizer

Appendix 11 : Planting in the large pots.

The third stage:

APPENDIX14: Results of Irrigation Water Variables (0%).

Analysis / DAY	PH	TDS(ppt)	SALINITY(%)	Conductivity(ms/cm)	temperature(C°)
05-05-2024	8.19	1.952	7.6	3.891	24.3
07-05-2024	8	2.014	7.9	4.015	25.8
09-05-2024	7.94	2.056	8.1	4.111	25.4
12-05-2024	8	1.308	5.1	2.616	25
14-05-2024	7.8	1.722	6.7	3.445	27.1
16-05-2024	7.91	2.087	8.2	4.189	26.6
19-05-2024	7.95	2.062	8.1	4.124	29.1
21-05-2024	7.95	1.965	7.7	3.891	27.7
23-05-2024	8.03	1.782	7	3.558	25.7
26-05-2024	8.01	2.04	8	4.079	25.7
28-05-2024	6.98	2.002	7.8	4.003	28.6
30-05-2024	7.21	2.084	8.1	4.151	28.8
02-06-2024	7.45	1.94	7.6	3.879	28.1
04-06-2024	7.25	2.048	8	4.099	27.6

APPENDIX15: Results of Irrigation Water Variables(100%).

Analysis / DAY	PH	TDS(ppt)	SALITY(%)	Conductivity(ms/cm)	temperature(C°)
05-05-2024	8.22	1.735	6.8	3.47	25.1
07-05-2024	8.2	1.391	5.4	2.783	25.7
09-05-2024	8.16	1.433	5.6	2.387	20.4
12-05-2024	8.12	1.781	7	3.563	25
14-05-2024	8.06	1.514	5.9	3.037	26.4
16-05-2024	8.12	1.472	5.8	2.945	29.8
19-05-2024	8.11	1.815	7.1	3.631	27.4
21-05-2024	8.3	1.473	5.8	2.945	24.2
23-05-2024	7.66	2.172	8.5	4.344	29.1
26-05-2024	8.14	2.306	9	4.612	27.9
28-05-2024	7.91	1.36	5.3	2.729	26.4
30-05-2024	7.92	2.558	10	5.111	30.7
02-06-2024	8.05	2.533	9.9	5.066	27.2
04-06-2024	8.18	2.525	9.9	5.052	24.2

APPENDIX16: Results of Irrigation Water Variables(50%).

Analysis DAY	PH	TDS(ppt)	SALINITY(%)	Conductivity(ms/cm)	temperature(C°)
05-05-2024	8.12	1.448	5.7	2.913	25.8
07-05-2024	8.11	1.698	6.6	3.383	25
09-05-2024	8.03	1.774	6.9	3.534	22
12-05-2024	8.16	1.503	5.9	3.004	24.9
14-05-2024	7.91	1.825	7.1	3.651	26.5
16-05-2024	8.11	1.777	7	3.565	28
19-05-2024	8.15	1.482	5.8	2.963	26.6
21-05-2024	8.29	1.764	6.9	3.553	25.5
23-05-2024	7.77	2.027	7.9	4.053	27.3
26-05-2024	7.31	2.084	8.1	4.168	30.4
28-05-2024	7.46	1.812	7.1	3.629	27.4
30-05-2024	7.7	2.245	8.8	4.491	30.87
02-06-2024	7.79	2.252	8.8	4.499	27.2
04-06-2024	7.9	2.242	8.8	4.481	25.8

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APPENDIX17: Results of Agricultural Drainage Water Variables (100%).

Analysis DAY	PH	TDS(ppt)	SALINITY(%)	Conductivity (ms/cm)	temperature(C°)
05-05-2024	7.88	4.635	18.1	9.269	27.4
07-05-2024	7.6	3.9	15.2	7.797	29.5
09-05-2024	7.55	3.306	12.9	6.612	26.7
12-05-2024	7.95	2.815	11	5.602	26.2
14-05-2024	7.66	2.455	9.6	4.917	26.8
16-05-2024	8.19	2.077	8.1	4.165	28.3
19-05-2024	7.91	1.963	7.7	3.927	30.4
21-05-2024	8.11	2.541	9.6	4.91	27.7
23-05-2024	7.72	2.936	11.5	5.874	31.4
26-05-2024	7.57	3.713	14.5	7.429	24.9
28-05-2024	7.55	4.717	18.4	9.425	30.2
30-05-2024	8.15	6.125	24	12.45	31.8
02-06-2024	8.07	5.527	21.6	11.06	29.8
04-06-2024	7.79	4.108	16.1	8.216	28.1

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APPENDIX18: Results of Agricultural Drainage Water Variables(100%).

Analysis DAY	PH	TDS(ppt)	SALINITY(%)	Conductivity (ms/cm)	temperature(C°)
05-05-2024	8.08	4.788	18.7	9.569	25.6
07-05-2024	7.73	4.973	18.8	9.578	28.1
09-05-2024	7.63	3.346	13.6	6.69	24.9
12-05-2024	7.78	2.379	9.3	4.763	25.7
14-05-2024	7.77	2.38	9.3	4.769	26
16-05-2024	7.87	2.13	8.3	4.26	28.5
19-05-2024	7.93	4.903	7.4	3.804	29
21-05-2024	8.13	2.637	10.3	5.292	26.3
23-05-2024	7.82	2.74	10.7	5.489	30.4
26-05-2024	8.11	2.376	9.3	4.752	24.1
28-05-2024	7.59	2.542	9.9	5.075	29.8
30-05-2024	7.98	5.774	22.6	11.53	27.1
02-06-2024	7.8	2.585	10.1	5.17	30.9
04-06-2024	8.02	2.014	7.9	4.024	28.4

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APPENDIX19: Results of Agricultural Drain age Water Variables(50%).

Analysis DAY	PH	TDS(ppt)	SALINITY(%)	Conductivity (ms/cm)	temperature(C°)
05-05-2024	8.27	4.75	18.6	9.502	26
07-05-2024	7.86	4.957	19.4	9.918	25.8
09-05-2024	7.87	5.447	2.5	10.97	23.9
12-05-2024	7.59	6.329	24.8	12.66	26.8
14-05-2024	8.15	5.872	23.1	11.74	23.7
16-05-2024	7.89	3.765	16.3	8.302	27
19-05-2024	8.24	4.198	27.8	8.394	27.8
21-05-2024	8.18	7.774	30.5	15.56	26.1
23-05-2024	8.05	3.856	15.1	7.701	27.1
26-05-2024	7.99	6.108	23.8	12.12	31.6
28-05-2024	7.84	6.533	13.07	13.07	25.6
30-05-2024	8.37	2.891	10.7	5.783	27
02-06-2024	8.19	7.249	28.3	12.43	30.3
04-06-2024	8.09	7.524	29.4	15.07	27.4

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APPENDIX20: Results of Agricultural Drainage Water Variables(50%).

Analysis DAY	PH	TDS(ppt)	SALINITY(%)	Conductivity (ms/cm)	temperature(C°)
05-05-2024	8.17	4.375	17.1	8.747	24.3
07-05-2024	7.54	4.883	19.1	9.765	26.5
08-05-2024	7.61	5.352	21	10.7	21.5
09-05-2024	7.41	4.355	17.1	8.711	23.6
12-05-2024	7.51	4.432	17.4	8.864	25.5
14-05-2024	7.68	3.571	13.9	7.121	26.1
16-05-2024	8.17	4.204	16.5	8.407	25.7
19-05-2024	7.96	4.952	19.3	9.939	27.2
21-05-2024	8.03	4.421	17.3	8.832	24.5
23-05-2024	8.19	5.397	21.1	10.79	29.2
26-05-2024	8.11	5.855	22.9	11.72	29
28-05-2024	7.67	2.641	10.3	5.287	26.8
30-05-2024	8.18	5.27	20.7	10.55	31
02-06-2024	8.01	5.278	20.6	10.53	29.3
04-06-2024	7.95	4.357	17.1	8.728	26.3

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APPENDIX21: Results of Agricultural Drainage Water Variables(0%).

Analysis DAY	PH	TDS(ppt)	SALINITY(%)	Conductivity (ms/cm)	temperature(C°)
05-05-2024	8.07	5.905	23.1	11.8	24.6
07-05-2024	7.65	4.878	19.1	9.744	25.7
09-05-2024	7.49	4.108	16.1	8.206	22.9
12-05-2024	7.61	3.664	14.3	7.31	24.7
14-05-2024	8.13	3.651	14.3	7.309	26
16-05-2024	8.32	3.609	14.1	7.182	24.9
19-05-2024	8.35	4.964	19.4	9.93	26.3
21-05-2024	8.08	3.705	14.5	7.408	23.4
23-05-2024	8.04	2.903	11.4	5.809	26.8
26-05-2024	8.18	4.384	17.2	8.742	28.2
28/05/2O24	8.26	3.882	15.2	7.775	27.6
30-05-2024	7.88	5.372	21	10.73	27.9
02-06-2024	7.94	3.807	14.9	7.614	28.3
04-06-2024	8.31	4.892	19.2	9.782	25.6

Appendix 12 : How drip irrigation system works