PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA
Ministry of Higher Education and Scientific Research
University of Mohamed Khider – BISKRA
Faculty of Exact Sciences, Science of Nature and Life
Department of Agricultural Sciences

MASTER MEMORY

Submitted in fulfilment of the requirements for the Masters degree in Agricultural Sciences

---

Option: **Hydropedology**

Presented by : Madoui Ahlem

Elaboration of thematic maps based on some soil characteristics cultivated by cereal under pivot irrigation

---

Jury :

Dr. GUIMER Kamel	MAB Biskra University	President
Dr BEDJAOUI Hanane	MAA Biskra University	Promoter
Dr MABREK Naima	MAA Biskra University	Examine
Dr Gouassem Lina	PHD University de oued souf	Co-promoter

Session: 2021/2022

First and foremost, thanks to Allah the most graceful and merciful for his showers of blessings throughout my research work to complete it successfully.

I'm extremely grateful to my parents for their care, love, encouragements and prayers. Special thanks to all my family members, for contributing by their love and support. I would like to express my deep and sincere gratitude to my research supervisor **Me Bedjoui Hanane** for the continuous support of my thesis study and research, I really admire his support and understanding all along the way. . I extend my appreciation to my precious friends and classmates, having such great people around me had a huge impact on my life and pushed me forward to always give my best.

To everyone i love and care about to my mom and my self, thank you.

MADOUI AHLEM

Summary

chapter 03: Materials and methods

Chapter 04: Results and Discussion

Figure list

Table list

Abriviation list

EAI: Enterprise application integration

EAC éducation artistique et culturelle.

Qx :Quintaux.

PH : Potentiel d'hydrogène.

m: mètre carré .

Max : Maximal mg : milligramme

Mg : Magnésium

Mini : minimale

ml : millilitre

mm : millimetre

Moy :Moyne

FAO : Food and Agriculture Organization

PH : Potentiel d'hydrogène.

CE : Conductivité Electrique

CEC:Capacité d'Echange Cationique

CRSTRA : Centre de Recherche Scientifique et Technique sur les Régions Arides

DA Déficit Agricole

DSA :Direction des Services Agricoles

ESP :Exchangeable Sodium Percentage (Pourcentage de sodium échangeable)

ITDAS :Institut Technique de Développement de l'Agriculture Saharienne

pH :Potentiel Hydrogène

SAR : Sodium Adsorption Ratio

CA: total calcaire

CT: total calcaire

Abstractnt

The productivity of Saharan soils depends on the variability of these properties at field scale. This study is aimed at determining the spatial variability of soil salinity, pH and soil calcareous The present study was carried out in Biskra loutaya (Casda). Soil samples were collected from a depth of 0 to 30 cm of tow pivot not cultivated for 4 years and planted with durum wheat. We randomly select 3 samples from each pivot, but we keep a long distance between an overview of the properties of the soil studied and the test. Both exhibit an alkaline soil with high pH values that classify the presence of soluble salts as follows: With the exception of sulfate, which has a higher concentration in the pivot 06 along with higher Na+, Ca++, and Mg++ analytical findings, extremely salty soils exhibit identical values of the ionic balance for the anions. The irrigation water , has acceptable quality for use but has a high percentage of salt. 4,16ds\m its the source of watering for the tow pivot Results showed a low to moderate spatial dependence for salinity, moderate for pH, and moderate to strong for total calcair . The adoption of the cart thematic gave us the distribution of heterogeneous concentrations for each parameter (Soils are saline and moderately to strongly calcareous for the tow pivot) Salinization would therefore constitute one of the main factors responsible for the decrease in durum wheat in the coming years .

Key words: Sahara-variation -salinity- pH- calcareous.

Résumé

La productivité des sols sahariens dépend de la variabilité de ces propriétés à l'échelle du champ. Cette étude vise à déterminer la variabilité spatiale de la salinité, du pH et du calcaire du sol La présente étude a été réalisée à Biskra loutaya (Casda). Des échantillons de sol ont été prélevés à une profondeur de 0 à 30 cm du pivot de remorquage non cultivé depuis quatre ans et planté de blé dur. Nous sélectionnons au hasard 3 échantillons de chaque pivot, mais nous maintenons une longue distance entre un aperçu des propriétés du sol étudié et l'essai. Les deux présentent un sol alcalin avec des valeurs de pH élevées qui classent la présence de sels solubles comme suit : À l'exception du sulfate, qui a une concentration plus élevée dans le pivot 06 avec des résultats analytiques plus élevés Na+, Ça++ et Mg+++, les sols extrêmement salés présentent des valeurs identiques de l'équilibre ionique pour les anions. L'eau d'irrigation , a une qualité acceptable pour l'utilisation, mais a un pourcentage élevé de sel. 4,16 ds/ m sa source d'arrosage pour le pivot de remorquage Les résultats ont montré une dépendance spatiale faible à modérée pour la salinité, modérée pour le pH et modérée à forte pour le calcaire total

L'adoption de la thématique panier nous a donné la distribution des concentrations hétérogènes pour chaque paramètre (Les sols sont salins et modérément à fortement calcaires pour le pivot de remorquage) . La salinisation constituerait donc l'un des principaux facteurs responsables de la diminution du blé dur au cours des prochaines années.

Mots clés :Sahara- géostatistiques- salinité- pH-calcaire .

ملخص

تعتمد إنتاجية التربة الصحراوية على تباين هذه الخصائص على نطاق الحقول المسقية بالرش المحوري تهدف هذه الدراسة إلى تحديد التباين المكاني لملوحة التربة ودرجة الحموضة و توزع التربة الكلسية أجريت هذه الدراسة في بسكرة لوطايا (كاسد تم جمع عينات التربة من عمق 0 إلى 30 سم من محور السحب يزرع لمدة 4 سنوات والمزروع سابقا بالقمح القاسي بمعدل 96 عينة اخترنا بشكل عشوائي 3 عينات م ن كل محور، لكننا نحتفظ بمسافة متباعدة لكل عينة لأخذ نظرة عامة عن خصائص التربة المدروسة حيث ظهر أن لكلاهما تربة قلوية ذات قيم درجة حموضة عالية لوجود الأملاح القابلة للذوبان .

تظهر التربة لكلا المحورين المالحة للغاية قيما متطابقة للتوازن ألايوني على النحو الأتي المغنزيوم والكالسيوم والصوديوم باستثناء الكبريتات، التي لها تركيز أعلى في المحور 06 مياه الري والتي هي مصدر سقي للمحورين ذات جودة مقبولة للاستخدام ولكنها تحتوي على نسبة عالية من الملح 4.

أظهرت النتائج اعتمادا على الخرائط التوزيع المكاني إن معدل الملوحة في مجال دراستنا غير متجانس و بتركيز عالي تناسبا مع تركيز الكلس العالي نسبة الملوحة العالية ستشكل خطر في خفض محصول القمح في المواسم القادمة .

الكلمات المفتاحية :الصحراء - الاحصاء الجغرافي – الملوحة - درجة الحموضة -الكلس .

Introduction

Algeria since the nation aims to achieve consistent cereal output, with durum wheat remaining the main component of Algerian diets. This annual herbaceous plant is more significant in terms of food**(TIR, 2007).**Cereal have a key position in the Algerian economy and is one of the biggest Because of these reasons, a significant portion of the area is dedicated to its cultivation. for agriculture, an estimate.

Unfortunately, Algeria covers onlya small portion of the world's production. This low yield and the 40% of needs are caused by a number of biotic variables (the either biotic (diseases, insect infestations, etc.) or a biotic (misuse of fertilizers, the environment, etc.)e.g., the edaphic structure, the precipitation, etc.), hence it can be explained by the non mastery**2019 /2020.(UNA ;2020)**

In recent years, the agricultural sector in the Saharan regions has undergone major change as a result of the statute 83_18 on access to agricultural land ownership (**A.P.F.A),** which i s the root of this new agricultural dynamic.

New farms are often built outside of the oasis as a result of the implementation of develop ment boundaries in the vast Saharan desert (**CHELOUFI and 2010 BOUAMMAR**).

According to one definition, soil quality is the product of physical, chemical, and biological characteristics that enable crops to grow and develop, regulate and divide water flows through the environment, and finally play a role in human health. filtering device that removes pollutants **(LARSON and PIERCE, 1992).** Soil composition demonstrates its ability to store and release water and nutrient-rich substances, to preserve its **(LARSON et PIERCE, 1992).**

Agriculture in the Saharan regions, and particularly Biskra, suffers from the risks of salinity and alkalinity problems over large areas. Salinization is a phenomena that occurs when soluble salts build up on the soil's surface and in the root zone. This has a negative impact on plants, lowers yields, and sterilizes the soil **(Mermoud, 2001).**

The aridity of the climate, the poor quality of irrigation water, the lack of drainage infrastru cture, and irrigation practices are the key factors that lead to the spread of the phenomenon of salinization of the land.

It is first required to characterize the occurrence of salinization in the Lotaya region and ass

ess its effects on the soil and vegetation. Due to this.Our project seeks to evaluate the salinit y of agricultural soils watered by pivotal irigation methods

Applying concepts based on variation in the field is necessary for efficiency in agriculture, which changes the need for calculating and mapping the geographic variability of soil parameters. There is some intrinsic spatial heterogeneity in soil quality in nature. related to differences in the interaction between soil parent materials and microclimate.

Uneven soil properties may be a reflection of processes taking place. In order to define the spatial distribution and model the spatial variability of geostatisticsby using analysis, soil characteristics, arggyce offers the most accurate unbiased linear prediction at the most accurate places. widely used

Our work will have an objective :

First of all ; l Insert the idea of working on the matimatic maps because it is a new idea for the master's students in our college with the aim of improving and calibrating the parameters essential to estimating the needs for more parameters to avoid and find solutions to many problems how related to agriculture

Second, by making characteristic maps based on certain traits (active calcair, total calcair, ph, andelectrical conductivity), we can gain a better understanding of the soil prodctvty in our research area at the pivot and regional sizes in dry and semiarid regions, particularly in the Biskra region Research on improving water quality and controlling irrigation in Biskra improvement in productcerealcultivation in Biskra(LotayaCasda)

The present thesis has three parts:

1. The first part is devoted to general information on cereal cultivation, general information on pivots, and the effect of salinity on the soil.

2.the methods used to complete this work

3-and the last part will deal with the results.

Chapter 01 :

General information on cereal in Algerian Sahara (Biskra)

1 Agriculture in the Algerian Sahara

Reflecting the ingenuity of a society that was able to overcome a hostile environment unfavorable to settlement, oasis agriculture is a fundamental element of the Saharan space (Bisson, 2003). The regions of the Sahara harbor important resources and potential to meet both the specific needs of these regions in terms of employment opportunities and food needs of the population and to play an important role in improving the nation's food security. The agro-climatic conditions of the foothills of the Saharan Atlas, the lower Sahara and even the central Sahara offer the opportunity to develop out-of-season production channels. Due to the disruption of the social stratification established for centuries (Madr 2020),

The main indicators revealing the importance of the place of this area in the national agricultural economy are ten (10) Saharan mandates: Adrar, Béchar, Biskra, El Oued, Ghardaïa, Illizi, Laghouat, Ouargla, Tamanghasset and Tindouf; Number of communes: 188 of which 141 are rural Ten (10) administrative districts: Bordj Badji Mokhtar and Timimoune (Adrar), Béni Abbes (Béchar), Ouled Djellal (Biskra), El Meghaier (El Oued), El Meneaa (Ghardaïa), Djanet (Illizi), Touggourt (Ouargla), In Salah and In Guezzam (Tamenghasset) Fourteen (14) natural region:The Land of Dayas, the Zibans, Oued Righ, Le Souf, Ksour, M'Zab, Ouargla, Gourara, Saoura, Touat, Tassili and Tidikelt. Area of the courses: 18 918 639 ha; Length of the border belt: 5 000 km. Total active population : 1 203 725 inhabitants including 465 177 agricultural inhabitants.

2 Agricultural activities of Algerian Sahara

Over the past decade, the Sahara's irrigated agricultural area (UAA) has grown by more than 106,000 hectares. Thus, it currently amounts to 355 911 ha which represents 30% of the total national A.I.S. The major agricultural regions are located in the **.** the Ziban, Oued Righ, Touat, M'Zab, Souf and Ouargla.

2.1 Phoeniculture

agriculture in the Saharan regions has always been based on the cultivation of the date palm (composed of about 1000 cultivars) because of its ability to adapt to harsh climatic conditions and is the essential element on which the entire Oasis ecosystem is based.
The evolution of the palm grove has been characterized by a period of abandonment (1960/1980) reflected by a regression of the productive potential, and aging of the orchard and a more significant positive step in the revitalization and evolution of phoeniculture, and this, thanks to the

means put in place by the government from 1980 to date.
The phoeniculture heritage is estimated 167 279 ha equivalent to a production of 10 255 000 qx, the variety Deglet Nour represents 53%, located mainly in the Zibans, Souf and Oued Righ.

2.2 Cereal

Despite the severity of its climate, the Saharan region has seen the development of cereal growing Thus, it currently amounts to 355 911 ha which represents 30% of the total national A.I.S. The major agricultural regions are located in the Ziban, Oued Righ, Touat, M'Zab, Souf and Ouargla.

2.3 other crops

That have experienced exceptional growth over the past ten years are vegetable crops currently occupying nearly 92 736 ha of which 41% are reserved for potatoes.
They are practiced in the Touat, Oued Righ, M'Zab and mainly in the Souf and Ziban.
19 196 ha are dedicated to fodder crops and 5 255 ha to industrial crops (tobacco, henna, saffron andtomato).
The livestock is dominated by sheep with a rate of 69% concentrated in the regions of Ksour Days, Souf and Ziban on the one hand and on the other hand the camel represents the specific activity of the wilayas workforce of 339,748 heads constituting almost all of the national workforce.

2.4 Arboriculture

the keeps an appreciable place with a surface of 21 203 ha. The main fruit productions, the olive tree whose area exceeds 10,800 ha, the apricot tree and pomegranate with the preeminence of the regions of Ziban and M'Zab.

3 Agricultures of Ziban

The Ziban Est (communes of M'ziraa, Ain Naga, Zribet El Oued) are renowned for field farming practiced in three-year crop rotation (market gardening/pulses/cereals).
This locality has experienced very strong agricultural changes thanks to the introduction of market gardening in greenhouses. There are small tunnels greenhouses (8 m x 50 m) but also large greenhouses such as the Canarian greenhouses and multi-storey greenhouses that can cover an area ranging from 1 to 5 hectares. The installation of these structures and the monitoring of the crops are ensured in particular by workers from Morocco who later became contractors installers (Bouzidi et al., 2015 This region sees the development of investor-based market gardening and entrepreneurial agriculture (Naouri et al., 2015). This pattern of development embodies the

sustainability of investments especially since this region does not benefit from the good soil climate conditions to grow date palm. On the other hand, the natural and pedoclimatic conditions of the West Ziban had allowed over time the creation of a set of scattered oases spread over about ten kilometers of a set of scattered oases spread over about ten kilometers. According to Côte (2005), an oasis refers to a group of Ksar (fortified village) and its cultivated territory (stepped palm grove). This Oasian agriculture was enabled by the availability of surface and ground water resources.According to Bernard (1939), the oasian agrosystem is conditioned by the nature of the water resource mobilized. In the case of the West Ziban, oases have appeared along the wadis, streams descended mainly from the Saharan Atlas (Hamamouche et al)

3.1 Total production in Biskra

-Total area of the wilaya : 2 150 980 Ha

-Total agricultural area: 1 652 751 Ha

-Useful Agricultural Area: 185 473 Ha

-Of which irrigated: 103 478 Ha

- Pastures and rangelands: 1 399 746 Ha

-Forest: 97 780 Ha

- Unproductive area allocated to agriculture: 67 532 Ha

- Unproductive area: 86 585 Ha

3.2 Irrigation and sources in Biskra

The Zyban region is located at the northeastern limit of the hydrological watershed of the Algerian Sahara and has enormous water potential, either underground (seven aquifers, Source ANRH Biskra), hydrographic network, and two dams (FOUM EL GHERZA and Fontaine des Gazelles).

The surface water resources are relatively unimportant and little exploited. They are irregular and consequently, their use is limited to the practice of flood agriculture which remains marginal. It is crisscrossed by four large wadis which are :

-Oued Djedi

- Oued Biskra

- Oued El Arab

- Oued El Abiadh

-The water mobilized:

- Number of boreholes: 8,328

- Number of wells: 3,573

-Number of ceds: 23 -

Springs: 17

- Pumping on the run of the water: 70 households

-The exploitation of groundwater is so important that the level of the water table is lowered and farmers are forced to dig deeper .

4 General information on cereal growing

4.1 Original and history of cereal growing

Cereals make up 45% of the energy supply in the human diet. Their organized use is at the origin of civilizations. According to Clerget (2011), three major groups of cereals correspond to 75% of world's cereal consumption. In Algeria, cereal growing plays a major role in the national economy, occupying the first place in strategic crops. The area occupied by cereals in Algeria is 8.5 million ha, which is very narrow compared to the total area of Algeria, which amounts to 238 million hectares of which 191 million are unproductive. In 2013, there were 600,000 cereal farmers or nearly 60% of the total farms without taking into account fallow land, according to the statistics of the Ministry of Agriculture.

Importance of cereals in Algeria

The cereals sector is at the top of the country's economic and social priorities. It has occupied a privileged place in the various socio-economic development plans that Algeria has drawn up since it gained independence. This is due to the role that cereals play as a basic necessity (MADR, 2011). Cereal products occupy a strategic place in the food system and the national economy. During the period 2010-2017, cereals occupied an annual average of nearly 40% of the UAA. The area sown to cereals during this decade is estimated at 3 385 560 ha, of which durum wheat and barley occupy the major part of this area (MADRP, 2018). . The importance of consumption makes wheat a strategic product from the point of view of food security (RASTOIN and BENABDERRAZIK, 2014). The national production of cereals for the 2017/2018 campaign reached 60.5 million quintals against 34.7 during the previous campaign, an increase of 74% (ONFAA, 2018). The quantities of imported cereals (wheat, barley, and corn) by Algeria have recorded a decrease of 9% for the year 2018 compared to the year 2017. As for the value of imports, the latter increased slightly to 2.5 billion dollars in 2018 against 2.4 billion dollars in 2017 (ONFAA, 2018).

4.2 Cereal farming in Sahara Algeria

Cereal growing in the Sahara faces constraints related to the poor control of the technical route. The decline in yields observed on cereal farms can be explained by many technical factors, such as weed infestation, poor seed quality and lack of access to water. In addition to these phenomena, these farms have been negatively affected by changes in the economic environment, particularly the increase in input prices. Cereal farms consume more inputs. The prices of these inputs have risen considerably since 1994, which has considerably deteriorated their profitability (BOUAMMAR B., 2000)

There is no conversion from a cereal production system to a phoeniculture production system. According to many cereal farmers, the palm grove was installed from the start and the choice of cereal growing under pivot was only a means of draining the support of public authorities. The poor quality of inputs (seeds, fertilizers, pesticides, etc.) is one of the major contributing factors to the poor yield and quality of crops produced by farmers in India's agrarian crisis. According to the opinion of some technicians and farmers, all the conditions were present to generate the dismal result that we are witnessing today: - Poor weather, soil erosion, waterlogged fields, excessive use of pesticides and herbicides, overuse of fertilizers and pesticides, and a host of other factors. The replacement of demonstrate by urea, which has been a factor in lowering yields, and restrictions on fertilizers for security reasons further accentuate this constraint.

In reality, there is no conversion from a cereal production system to a phoeniculture production system. According to many cereal farmers, the palm grove was installed from the start and the choice of cereal growing under pivot was only a means of draining the support of public authorities.

Importance of cereals in the Saharan regions of Algeria

In Algeria, as early as 1965, and within the framework of a scientific cooperation agreement, a Soviet mission settled in the state of Ouargla (DDA of the oases) at the experimental station of Sidi Mahdi.The work of this mission focused on some problems of Saharan agronomy, including the cultivation of cereals (CHAOUCH, 1988).

The introduction of cereal growing under pivots in the Saharan zones was for the first time in 1986, to create cereal areas to be equipped in pivot center, provided for the sowing of 10 000 ha and 70 000 ha in 1989 by the creation of two types of farms:

Individual farms within the framework of the law of the APFA launched by the State with the use of the new techniques of productions. The installation of the first pivotal centers in the south within this framework dates back to 1986 and 1987 when they were installed in two States: The first of 10 ha in Adrar (Sbaa area) and the second of 50 ha in Ouargla (Ain Zekkar).

Large modern farms, created as a test: these are pilot farms for cereal production using modern irrigation methods known as pivot centers. The equipped surfaces during the first campaign 1986 - 1987 are about 2249 ha with 46 pivots, 2167 ha with 44 pivots in the state of Ouargla, and 82 ha with 2 pivots in Adrar (BENBRAHIM, 2009). According to CHAOUCH (2016), the farms created within the framework of law 83/18 on APFA and decree 97-483, relating to the concession, are located in spaces far from urban areas and even "isolated". They are large farms of 64 to 200 ha which can reach 1670 ha created with the objective of producing strategic crops, in particular cereals irrigated by pivots. Except for the ERIAD farm of EPIC status, they are recent farms created by the State and attributed to entrepreneurs, traders, and even civil servants

4.3 Cereal growing in Biskra

For cereals are very old practiced on spreading of wadi floods in the region of Zab Chergui and Zab El Ghabli (Doucen -Ouled Djellal) during the rainy period's hundreds of hectares will be plowed: either by the breeders for a supplement of fodder to their livestock and self-consumption. or by the sedentary ones for the fodder of the family breeding and the self-consumption In addition, the enthusiasm and orientation of the agro-pastoralists to cultivate cereals (to provide for the needs of the livestock and to have self-consumption) and market gardening in the open fields and also under greenhouses will allow them to realize important productions and to develop a very varied range of vegetable and animal productions which contribute in an effective way to food security. A attracts the attention of the State to develop this region through investment programs, specific, subsidies, and also a policy of encouraging, encouraging farmers to modernize the cultivation methods of all sectors, have allowed multiplying the productions. These results obtained have attracted national and foreign investors to invest in Agriculture, and have increased the areas under cultivation by irrigation and by spreading of wadi floods.

Number of agricultural exploitations: 61 365 of which:

- EAC: 44
- EAI: 1 242
- Pilot farm 1:
- Private farms: 27,365
- Concessions: 20,746

- Other: 11,967

- Despite the severity of its climate, the Saharan region has seen the development of cereal farming occupying more than 81,900 ha located mainly in the Ziban and the Dayas country.

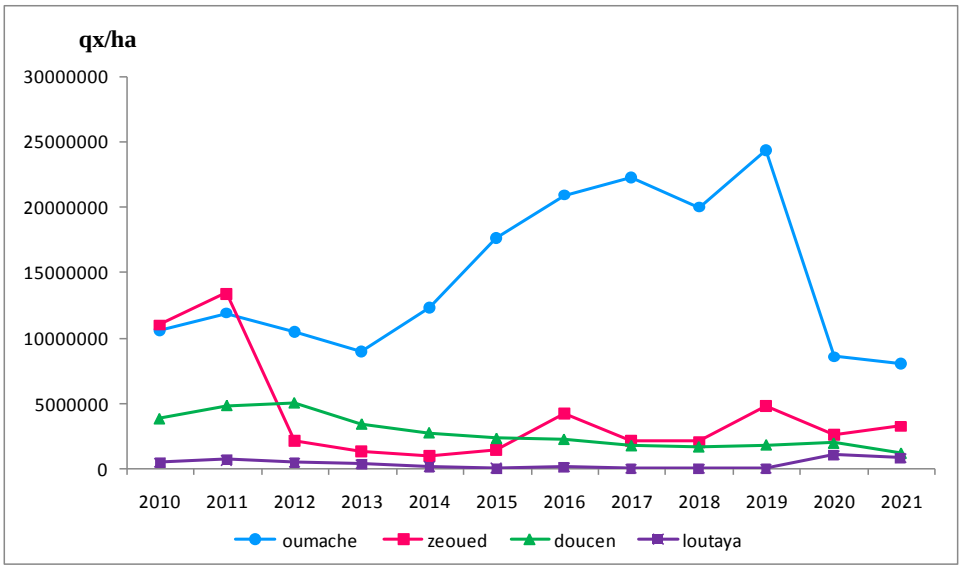

Figure 1 : Production of cereal Biskra (CCLS ,2021)

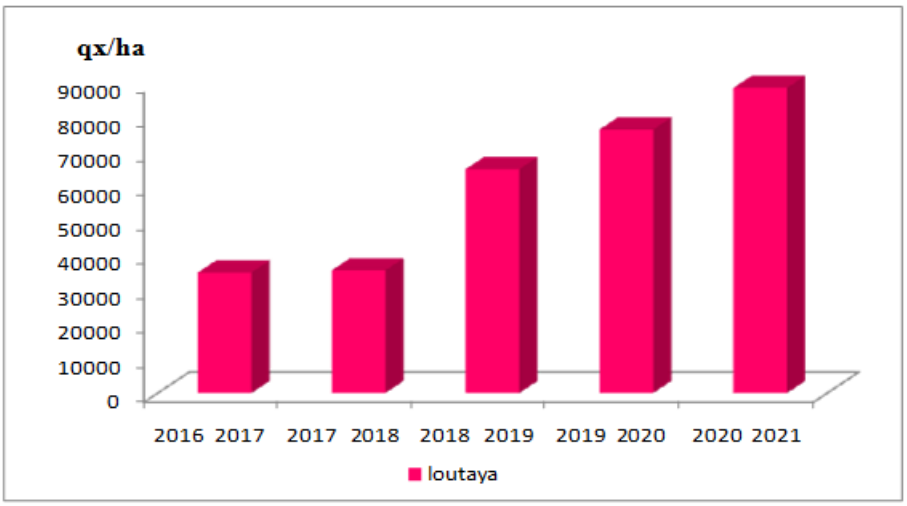

Figure 2 :Production of cereal Lotaya (DAS, 2021)

Chapter 02 :

General information on the pivot irrigation system

1 Definition of irrigation

Irrigation is the process of artificially supplying water to crop plants to increase production and allow for their natural development, when there is a shortage of water due to lack of rainfall, excessive drainage, or a decrease in groundwater, especially in arid areas. Nevertheless, irrigation improves the yields of agricultural land, but involves the use of large amounts of water. The amount of irrigated land has increased significantly to meet growing population and food needs. With 70% of the world's water consumption, agriculture is undoubtedly the most water-intensive sector of activity. Types of irrigation techniques include surface irrigation, sprinkler irrigation and drip irrigation.

2 General information on pivots

2.1 History of pivot

This system has known a considerable development since 1952 when the use of watering pipes appeared which were transported from one place to another manually or towed by tractors. Then the wheel drive system was introduced. Therefore, in 1952, after overcoming these difficulties, the pivott irrigation system was widely applied in many American regions such as NEBRASKA where farmers were the first to use this system in a region of livestock and pasture .This system has undergone considerable development since 1952, when water pipes were started to be transported from one place to another manually or towed by tractors. Then the transmission system was introduced. As a result, in 1952, after overcoming these difficulties, the pivott irrigation system was widely applied in many US regions such as NEBRASKA where farmers were the first to use this system in a livestock and grazing area.

2.2 Presentation of pivot

2.2.1 Classification of irrigation machines

The general term "irrigation machine" is generally used to designate any more or less automated device that irrigates while moving. There are four main types of irrigation machines:

- The devices watering in circles, according to a diameter called giant sprinklers.
- The devices watering juxtaposed bands while moving, called self-propelled guns.
- The devices watering in rectangles, with continuous frontal displacement during the watering, called frontal ramps.

- The devices watering in a circle according to a radius, generally called: pivotting booms or pivot system.

2.2.2 Irrigation with pivot

The pivot, also known as a pivot boom, is a mobile irrigation device that rotates a circular or semi-circular area. Pivot irrigation was invented in the USA in the late 1940's and started in France in the 1960s. Well suited to irrigating large areas, the pivott was first developed in the flat areas of the Landes, on large plots. The "ideal" length of a pivot is around 450 m, i.e. a plot of about 65 ha.

Figure 3 Cereal crop under pivot

The electric operation of the pivot offers great flexibility of use and allows the watering of non-circular plots.

Pivot irrigation must be reasoned according to four criteria:
- the daily dose to be applied, which makes it possible to calculate the flow rate of the installation;

- the depth exploited by the roots and the soil's retention capacity, which determine the dose per passage;

- the soil's infiltration capacity, which influences the admissible rainfall intensity;
- the rhythm of the passages, which takes into account the climatic constraints of the period

2.3 Principle of pivot irrigation system

The pivot is made up of a long pipe, rotating around an axis or pivot length, turning around an axis or pivot by which the arrival of water and electricity .

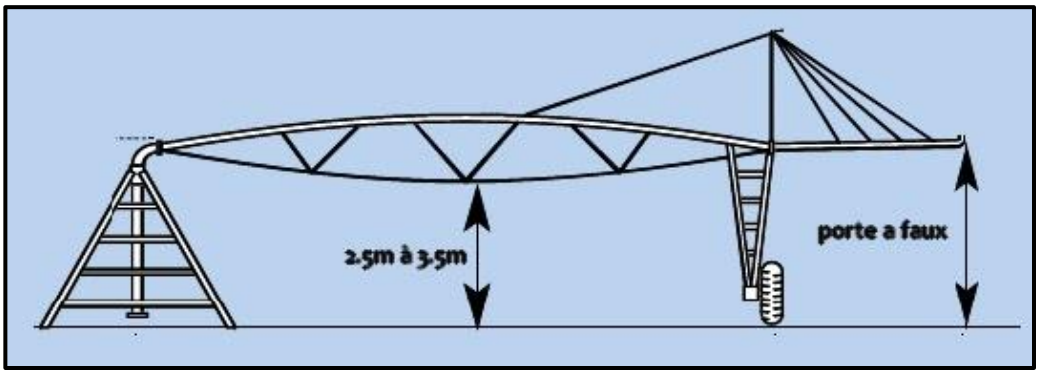

Figure 4 Diagram represents the dimensions of a pivot

The pipe is carried, from one end to the other, by towers equipped with wheels, driven by electric motors. The towers separate the device into spans rigidified by a system of triangulation and tie rods, the pipe acting as a beam. Water is distributed by sprinklers or nozzles placed along the pipe. An end cannon, placed at the end of the cantilever, often completes the equipment.

The movement of the boom is discontinuous, the alignment of the whole is controlled at the level of each tower by contactors, sensitive to the angle formed by two contiguous spans

2.3.1 Technical description of a pivot

- central element

The central element is generally fixed on a concrete slab equipped with anchors sealed in studs whose volume depends on the type of structure of the machine.

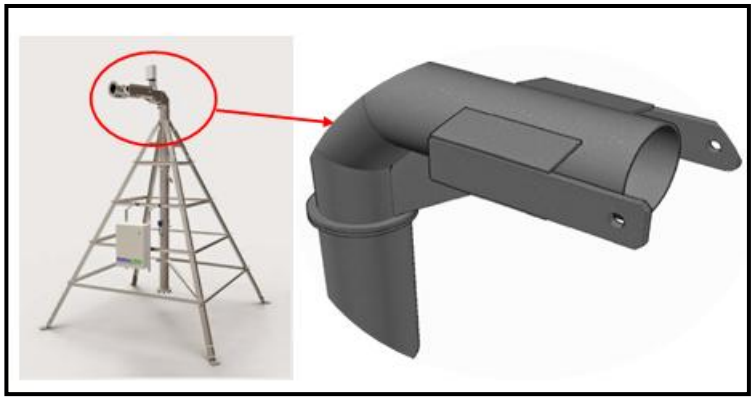

Figure 5 Central element

When the machine is equipped with an inter-mittent end cannon, the control of the solenoid supply valve can be done from the central element .

- Towers

The towers support the pipe. They are equipped with wheels driven by electric or hydraulic (oil) motors controlled sequentially by micro-switches ensuring the alignment of the spans between them.

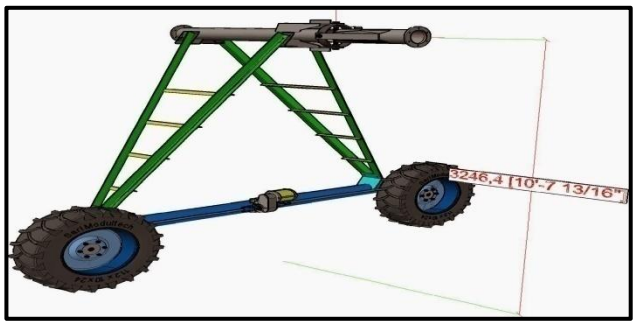

Figure 6 Towers of pivot

-Spans

They are made up of a pipe serving as a beam, rigidified by a structure. With a length of 30 to 65 m, they leave a clearance under the structure of 2.5 to 3.5 m, for a total height of 3.5 to 5 m.

The pivots used in arboriculture, can leave a clearance under structure of 5.5 m at least

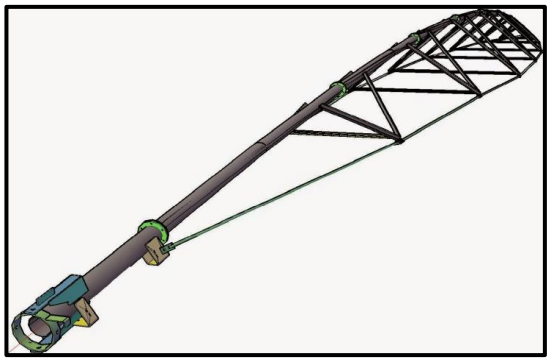

Figure 7 Spans of pivot

- Drive train

The geared motors ensure the movement of the towers. They consist of an electric motor and a gearbox. The electric motors have a power of 0.25 to 3 HP (0.18 to 2.2 kW), they

are placed on the towers, in the middle of the crossbar that connects the wheels. The gearbox divides by 20 to 50 the speed of the motor .

- Transmission

Transmission between the motor reducer and the wheels, uses different systems (connecting rods, chains, cardan shafts).The transmission by cardan shaft at the exit of a reducer is generalized.

Wheel gearboxes divide the speed of the transmission by 50. There are worm gearboxes or epicyclical gearboxes, which require a brake.

-The pipe

The pipe is generally made of galvanized steel. It is made up of 6 or 12 m (20 or 40 ft) elements, assembled together by bolted flanges. Its diameter varies from 114 mm (4.5 inches) to 219 mm (8.5 inches) and even 254 mm (10 inches) for the largest S275 steel units. Its thickness varies from 2.5 to 4.0 mm, depending on the situation(abrasion, corrosion, transport of various products).

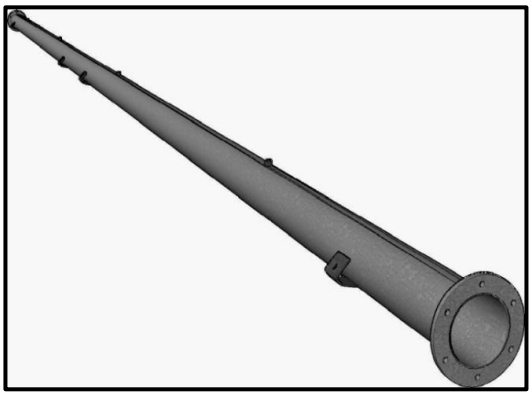

Figure 8 Pipe of pivot

It can be coated inside (paint, polyethylene).The pipe is equipped with tappings at regular intervals (1 to 3 m) intended to receive the watering devices.

-The cantilever

In order to increase the irrigated surface, the bay located opposite the central unit is usually extended by a cantilevered pipe of variable length (from 6 to 24 meters on the ground), which is most often equipped with an end cannon. It is fed by a booster if the residual pressure requires it, and operates continuously or intermittently to adapt to the shape of the plot of land, which can have a range of up to forty meters

Figure 9 Cantilever of pivot

-Gear motors

Ensure the movement of the towers. They consist of an electric motor and a reducer. The electric motors have a power of 0.25 to 3 HP (0.18 to 2.2 kW), they are placed on the towers, in the middle of the crossbar that connects the wheels. The reducer divides by 20 to 50 the speed of the motor .

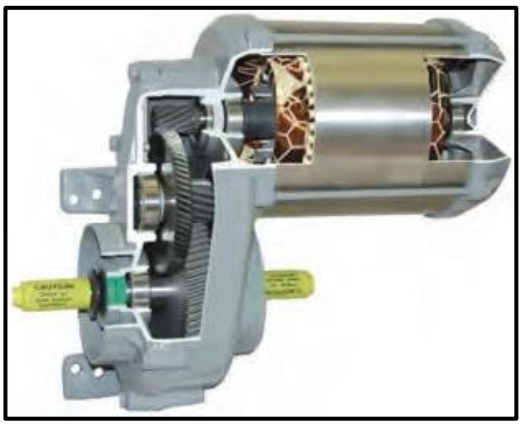

Figure 10 Gear motors of pivot

- Wheels

We offer two alternatives, the choice will depend on the admissible ground pressure, the rainfall, the size of the machine and the type of work.

Figure 11 Wheel of pivot

2.3.2 Different types of sprinklers

Figure 12 Different types of sprinklers

Ramp irrigation systems can be equipped with different types of sprinklers, each with its own particular constraints **:**

-Sprinklers: single or dual nozzle sprinklers, made of brass or plastic, with a low angle (about 7°) to reduce the wind load by limiting the height of the spray. They require a pressure higher than 2.0 bar. Their range is between 12 and 18 m, allowing to reduce the average intensity of the watering.

-Nozzles or Sprays: these watering devices operate at low pressure (0.5 to 3 bar). Their short range (maximum 5 m) leads to high rainfall intensities, so they should be avoided on low permeability soils. They can be used with downspouts to combat the effects of wind.

- Rotating deflector nozzles:

these sprinklers use a rotating deflector (rotor), operating at medium pressure (from 0.7 to 4.0 bars). They can be placed at the end of descent canes, the rotor can emit 1 to 6 jets depending on the flow. Their range varies between 8 and 14 m.

3 Advantages and disadvantages of pivot irrigation techniques

3.1 Advantages

- Water saving
- Generally low labor requirements;
- Possibility of watering all types of soil;
- Being able to achieve a very homogeneous and well controlled watering;

3.2 Disadvantages

Requires a certain level of competence of the farmer; High energy expenditure; Reduced efficiency in windy regions; Poor adaptation to "beating" soils; Circular shape of the watered surface Difficulty of moving the equipment in high crop areas (SAIYOURI et al., 2012)

4 Irrigation water classification criteria

The main water characterization parameters are: salinity, sodicity(SERVANT, 1978) and the chemical facies (SAFAR, 1983).

According to SERVANT (1978), salinity is usually expressed by the electrical conductivity en dS/m at 25°C. The sodicity of water reflects the property that this water increases the proportion of exchangeable sodium when it is brought into contact extended with the ground: irrigation, flooding, and groundwater rise.

The parameter most used to determine the sodicity is the SAR (Sodium adsorption ratio).The Riverside Laboratory classified the waters according to their salinities and the danger of alkalinization which can occur in the soil (RICHARDS, 1954); the classesde termined are:

4.1 Water salinity

- C1: W.C. at 25°C < 0.25 dS/m: non-saline water, usable for irrigation of the

most crops on most terrains with little chance of occurrence of salinity in the soil.

- C2: W.C. at 25°C between 0.25 and 0.75 dS/m: medium salinity waters, usable with a light washing. Plants moderately tolerant to saltscan grow in most cases without the special practice of controlling the salinity
- C3: C.E. at 25°C between 0.75 and 2.25 dS/m: water with high salinity, unsuitable for soils with restricted drainage. Even with good drainage, special salinity control practices may be needed and plants with good salt tolerance can be grown alone.

- C4: W.C. at 25°C between 2.25 and 5 dS/m: waters with very high salinity, normally unusable for irrigation. Exceptionally, they may beused on very permeable soils with good drainage and with a dose of excess irrigation to ensure strong soil leaching. Cultivated plants must be very tolerant of salts .

4.2 Alkalinity and hardness

Alkalinity and hardness are two notions intimately linked to the risk of clogging the drip system. Hardness refers to the amount of calcium and magnesium contained in the water. These two elements come from the weathering of the rock mother. Alkalinity, on the other hand, is a measure of the power of water to neutralize acids, It's a bit like the "buffering power of water". In Quebec, water rich in calcium and magnesium generally has equivalent amounts of bicarbonates or carbonates, which give it high alkalinity.

4.3 Electrical conductivity (EC) and Hydric potential(pH)

When the water from the drippers evaporates, or when the pH or the temperature of the water irrigation changes slightly, the calcium and magnesium bicarbonate precipitates in the form of sequins.

These migrate through the network and settle inside the drippers, gradually causing them to clog. To counter this risk, we must lower the pH of water below pH 7. Periodic treatments with nitric or sulfuric acid will eliminate these deposits. Once the acidification process has started, the reaction then produces water(H20), carbon dioxide (C02) which is released into the air, as well as the cation companion (either calcium or magnesium)

The pH of a solution is the amount of free H+ ions it contains (Soltner,1982). pH = 1/log (H+). The pH is measured on a fine soil suspension (Aubert,1978). The accumulation of soluble salts in a soil profile reduces its pH, but in the case of alkaline soil, the pH increases with salinity due to the presence of bicarbonates and sodium carbonates (Gupta et al., 1990).

According to Khatir(2002), salt soils generally have a pH greater than 7, and can reach values wellabove 8.5 when there is a high abundance and chemical diversity of salts depending on the pH value of a soil.

The electrical conductivity of a solution is the conductivity of this solution measured between two electrodes of 1 cm2 of surface. It determines the overall salinity of water or of the saturated paste extract or diluted soil extract. It is expressed in dS.m-1 (Baize, 1988).

Chapter 03:

Materials and methods

We have devoted this chapter to the presentation of the workstations and the different methods applied in the field and in the laboratory aiming to inventory the associated with cereals in the Biskra (lotaya) region.

We also present methods and techniques for analyzing results such as ecological indices and statistical analyses. Overview of the study area

1 Presentation of the Biskra region

1.1 Geographical location

Biskra city is located in the North-East of Algeria, about 470 km south-east of Algiers, it covers an area of 2167.2 km².

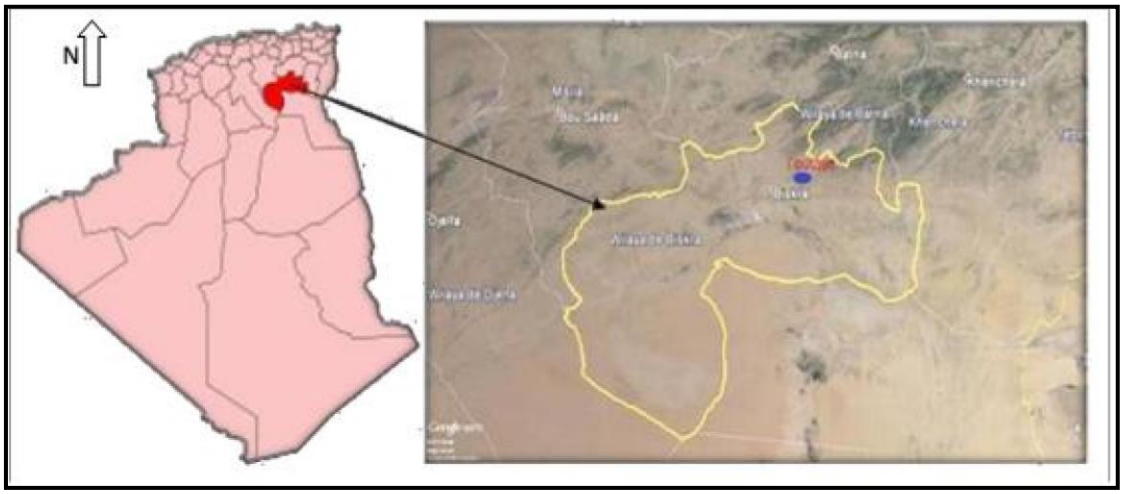

Figure 13 Map of the location of the BISKRA wilaya (via googleearth)

and currently has 12 dairas and 33 communes. It is limited to:

- North: The city of Batna
- Northwest: M'Silawilaya
- Southwest: The city of Djelfa.
- Northeast: Khenchelawilaya

Its altitude is 125 meters at sea level. Biskra occupies an area of 21.671.2 Km² with a density of about 30 inhabitants/km²

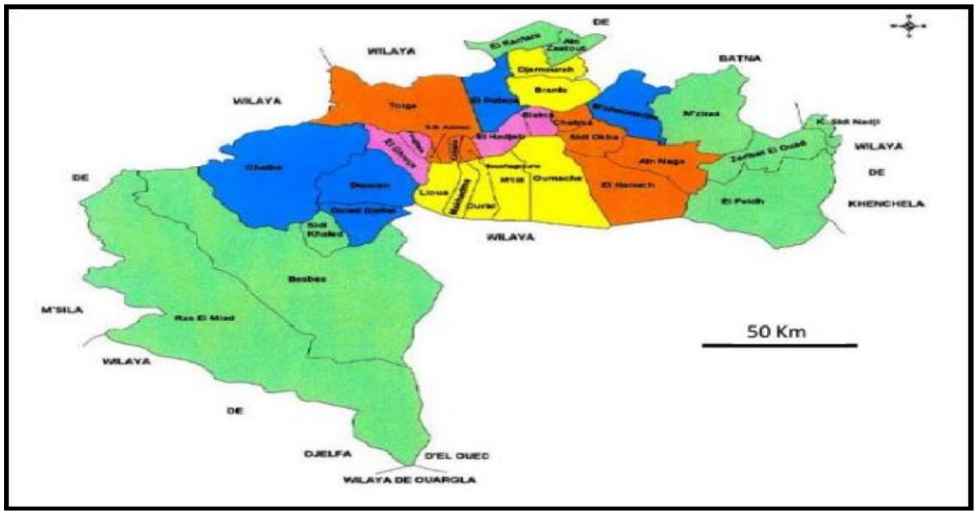

Figure 14 Administrative division of the Biskra wilaya (monograph of Biskra 2017)

1.1.1 Relief

Biskra wilaya is the transition between the North Folded Atlases and theof the Sahara to the South. One passes from a rather high and rugged relief to the north at a plateau topography slightly inclined towards the south. The relief of the wilaya of Biskra consists of four large geomorphological groups (Anonymous, 2003 cited by Boucetta, 2018).

1.1.2 Mountains

Present only 13% of the total area according to Anonymous, (2007), the overwhelming majority is in the north of the region of Biskra, the North slope has the forest formation that is connected with that of the forest of Aures, while the southern slope is turned towards the plain of Biskra with very low vegetation. The highest point and the DjbelTaktyout with an altitude of 1942 m.

1.1.3 Trays

Anonymous, (2007) Plateau de OuledDjellaletSidi Khaled; 50% of them have large flat or weakly rugged areas, located in height and located in the south-western side of the Wilaya de Biskra.

1.1.4 Plains

According to Anonyme, (2006) they occupy 28% of the total area, including the plains of Loutaya, Doucen, SidiOukba, and Zribet el Oued.

1.1.5 Depressions

Located in the south-east of the wilaya, they constitute a plate where water bodies are formed very thin making up the chotts of which the most important is the Melghir chott level can reach -33m below that of the sea

1.2 Geology and geomorphology

According to the geological map of the Biskra region at 1/200,000, it can be concluded that this region, structurally and sedimentary, is transitory between the northern part made up of mountains and the south which is a collapsed country made up of plains. According to (Guoskov, 1962) it is part of the northern Sahara and on the other hand, in very lower position appears the last anticline towards the south of the Saharan Atlas.

Khechai, (2001) the passage between these two distinct domains is through a set of folds and faces oriented in the West, called «Saharan flexures» marked by Atlasic tectonics. These last two groups played a drop which allowed the trials to recover. The region and its borders are made up of limestone and cretaceous marl with gypsum interactions, the latter generally forming the mountainous framework A.N.A.T.,

(2005) Most of the rocks are carbonate. and sedimentary.

The dominant essential character of these formations is that of salts (Limestone, Gypsum, Soluble salts). According to A.N.R.H., (2005), the folds of DjebelBoughzel and the local gaps (Sebkhat) are generated by tectonic movements that have affected the existing formations of the region followed by erosion phenomena .

1.2.1 Hydrogeology

Following the geological map of Biskra (we can distinguish the different valley crossing this region which are as follows:

Wadi Biskra takes its origin from wadi Abdi and Wadi El-Hai. Oued Ezriba which owns its origin in the Oueds of Kattan and Oued El Arabe. Oued of Zeb west, Oued El Hay, and Oued of Ouled Djellal according to (Anonymous, 2007) are characterized by irregularity and little runoff.

WadiDjedi, according to (Anonymous, 2007) has a length of 500 km and constituted the collection of the runoff of the South.

East plan of the Saharan Atlas. All valleyare defined by an endpoint flow.

According to (Durand, 1953) the hydrogeology of the region of Biskra is characterized by the presence of the four main layers, where the explanatory note of the hydro geological map of Biskra distinguishes the following layers:

- Quaternary groundwater.
- The Eocene and Senonian limestone layer .
- The Miopliocene Tablecloth.
- Deep Continental Layer – Albianlimestone .

1.2.2 Pedology

The main soil types in arid regions according to the French classification made by the (Laboratory of Geology Pedology of Paris, 1967)are:

- Salt soils
- Limestone soils
- Soils with an accumulation of salts
- Gypsum soils ,Gypsum-limestone soils Whereas the studies carried out by Khechai, (2001) at the Wilaya de Biskra, show that there is a heterogeneity of soils in the Biskra region. From the North, characterized by mountains where the soils are limono
- clay through the perimeter of the Outaya to clay soils

- salty in the SidiOkba area, east of Biskra of the limestone soils sandy in the Ziban area, for this the different types of soils encountered are:
- Limestone soils.
- Gypsum soils
- Limestone gypsum soils
- Salt soils
- Clay soils – sodium
- Low-grade alluvial soils.
- Colluvium soils
- Wind-forming soils

1.3 Climate Data

The Biskra region is characterized by a semi-arid to an arid climate, with a hot, dry summer and a cold, dry winter (DPSB 2016).

1.3.1 Precipitation

Precipitation is an ecologically important factor. Biskra is a dry area with low rainfall. For the period(2015_2020) and (1988_2018) Figure 15 shows the average monthly precipitation during the period (2015-2020), noting that a rain irregularity is noticed with a peak in April with(22.52mm), and the lowest precipitation is in July (0.41mm).

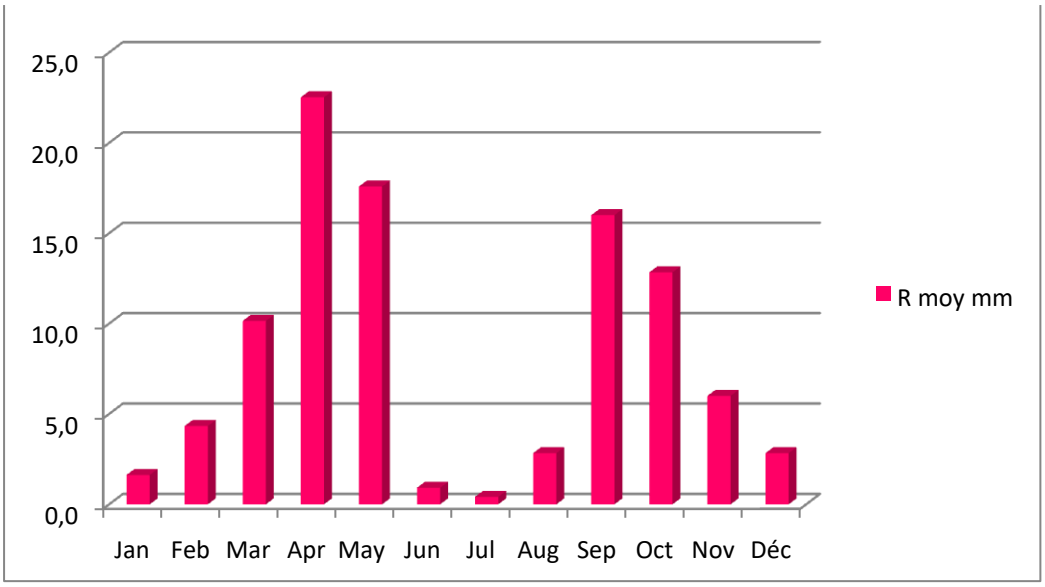

Figure 15 Monthly precipitation in Biskra region during the period (2015_2020)

Figure 16 shows that the total annual precipitation in the Biskra region is very weak and characterized by a remarkable irregularity with maximum dryness that was recorded during the month of July with a rainfall of 1.5 mm and the most watered month september 20.8 mm .

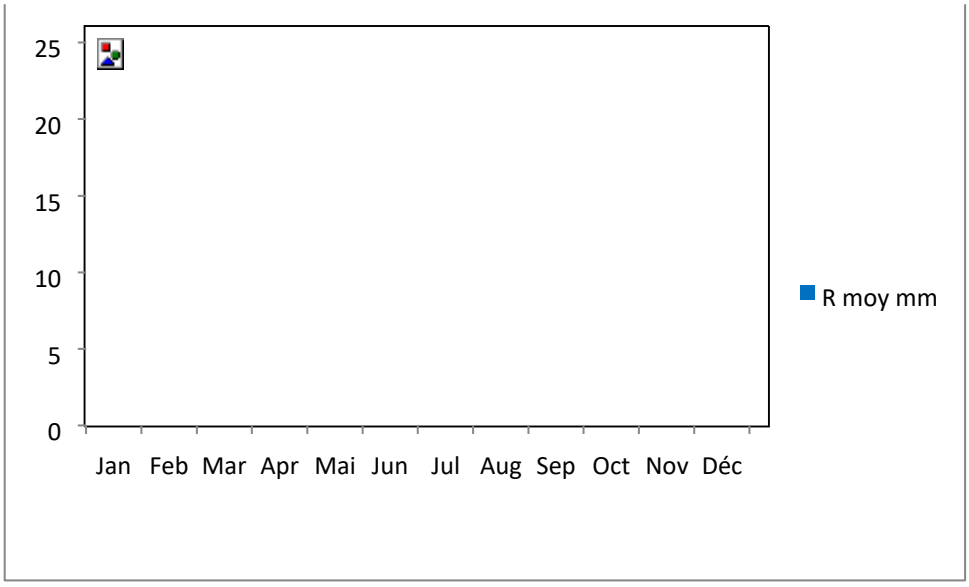

Figure 16 monthly precipitation of the Biskra region during the period 1989 _ 2018

(ONM)

1.3.2 Temperatures

Temperature is the second factor after precipitation that conditions the climate of a region (Laib, 2014)

Figure 17 During the period (2015.2020), The warmest month July 35°C and the coldest month are January with 12.58 °C

Figure 18temperatures in Biskra area (1988_2018)

temperatures minimal:lowest temperatures in January with 6 °C and the highest in July and august with 27.2 °C

temperatures maximal:lowest temperatures in December with 13.7 °C and the highest in July with 40.1 °C

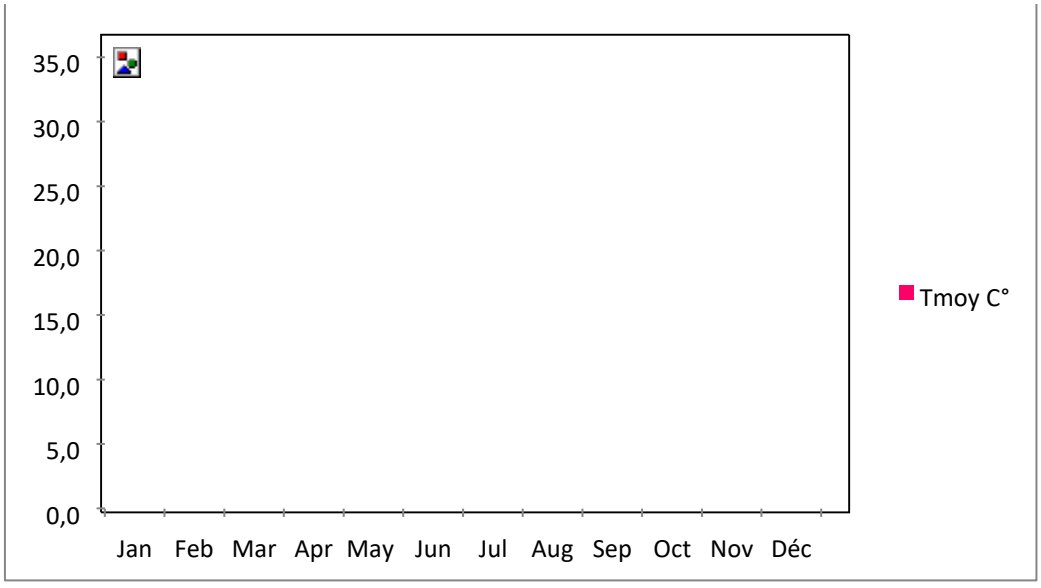

Figure 17 Medium temperature in Biskra area (2015_2020)

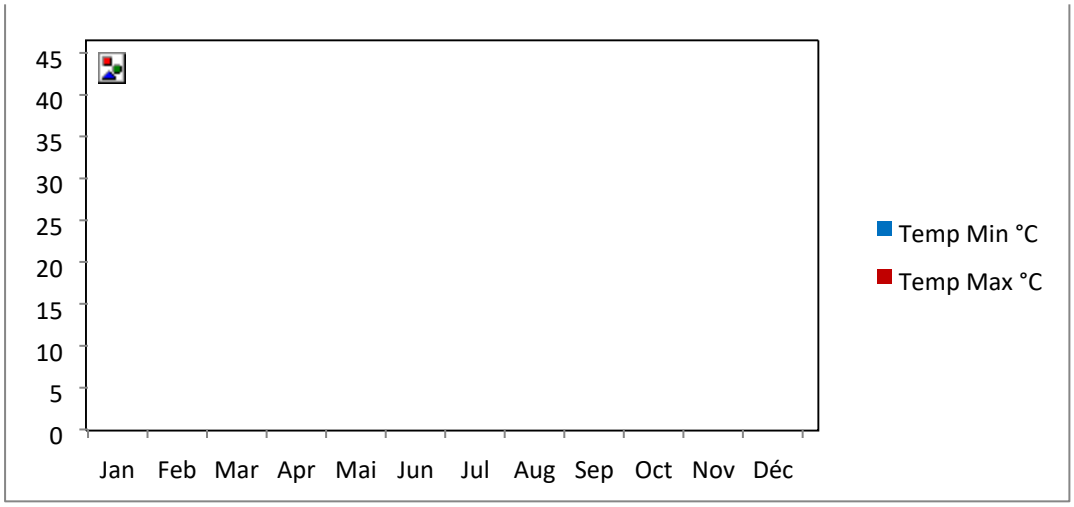

Figure 18 Temperatures minimal and temperatures maximalin the Biskra area (1988_2018)

1.3.3 Relative Humidity

According to Ramade (2003), this is the ratio between the water vapor content of the air and the theoretical mass of water vapor that may be contained in the saturated atmosphere given the existing temperature and barometric pressure.

Figure 19shows the Relative Humidity in Biskra area (2015_2020) Air humidity in the region Generally, is high during april,22.52% and The lowest humidity is observed in july with an average of 0.91%

Fiure 20 shows the Relative Humidity in Biskra (1988_2018) that the month of noveember is the wettest with 52% however the lowest humidity is noted

in July with 19 % .

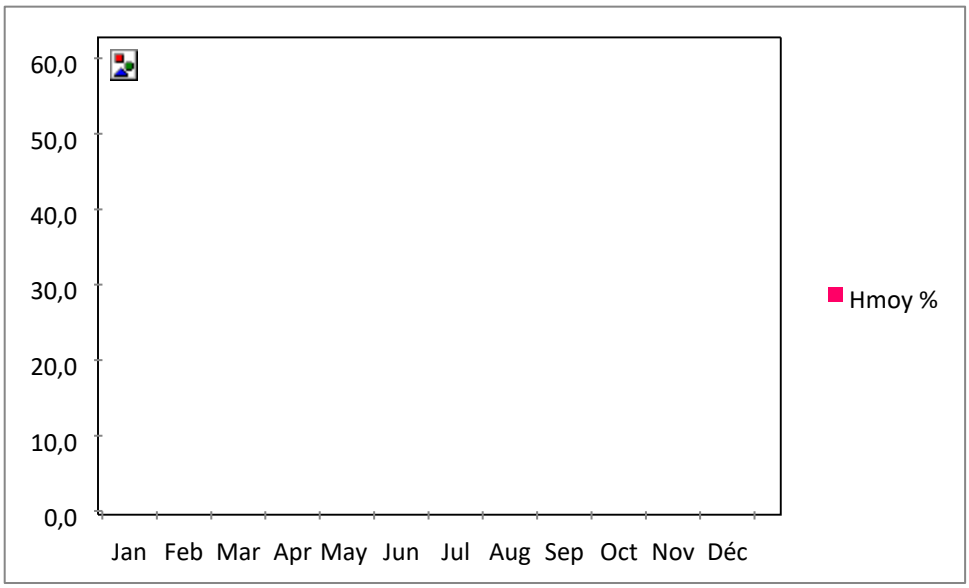

Figure 19 Relative Humidity in Biskra area (2015_2020)

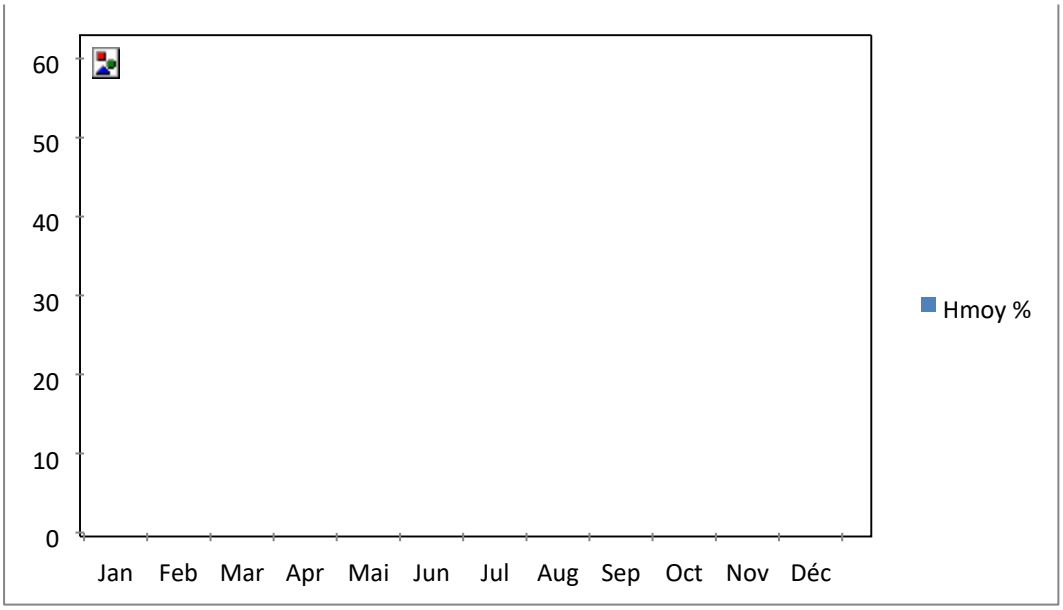

Figure 20 The average monthly humidity of the Biskra region during the period 1989-2018 (ONM)

1.3.4 Wind

It is a continuous phenomenon in the desert where it plays a considerable role in causing a intense erosion thanks to the sandy particle that it transports in return a sedimentation also important which results in the formation of dunes (Ozenda.1983). asit is one of the factors that increases the evapotranspiration that helps to dry out the

atmosphere. Mean wind speed data for the study area the recorded results indicate for the period (2015_2020) and (1988_2018)

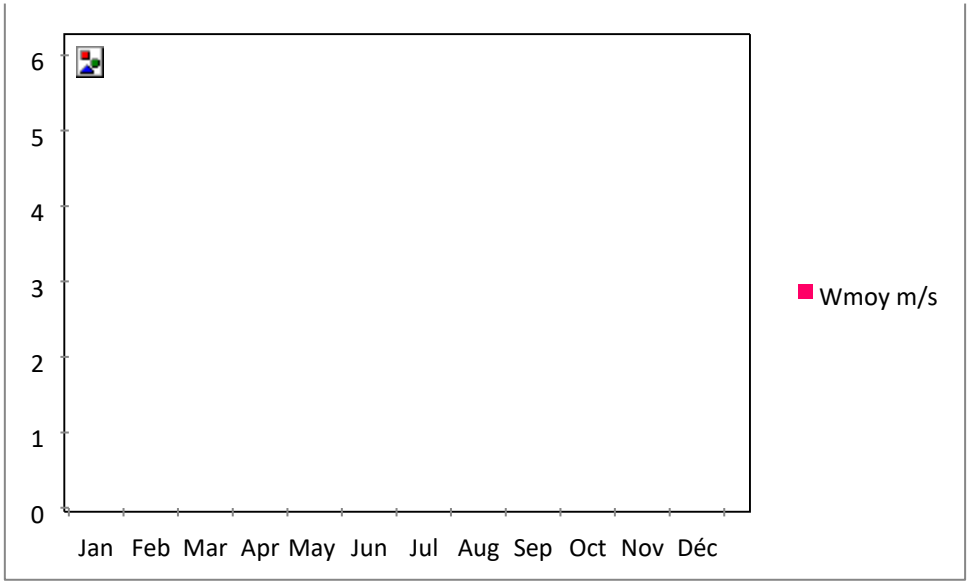

Figure 21 Average monthly wind speed in the Biskra region during the period (2015 – 2020)

Figure 21 **(2015_2020)** the maximum wind speed was marked at prices of March and April for a value of (5.12 m/s,4.51 m/s) and the minimum speed during September for a value of 3.46 m/s and Figure 22 **(1989_2018)** The maximum wind speed was recorded in December with an average of 5.9m/s. However, the minimum was raised in July with 2.7 m/s.

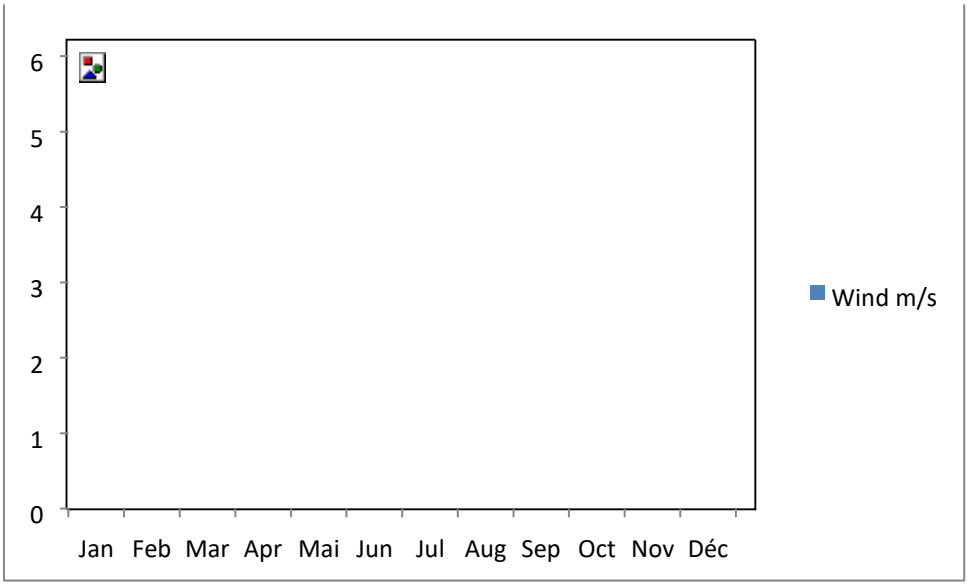

Figure 22 monthly wind speed in the Biskra region during the period 1989 _ 2018 (ONM).

2 Presentation of the Loutaya Study Area

2.1 The El-Outaya site

The municipality of El Outaya (35° 1' 60' N; 5° 36' 0' E) is one of the cereal growing areas, the largest in the Zeban region; it is located north of the city of Biskra with an area of 409.08 km². According to Farhi and Belhamra (2015), the El-Outaya plain is at the edge of the semi-arid (High Plains) and hyper-arid (Sahara) bioclimatic stages. The average annual rainfall is small and does not exceed 200 mm per year

2.2 Geographical information about the city El Outaya

Geographic coordinates of El Outaya: Latitude: 35.0333, Longitude: 5.6 35° 135° 1 60 North, 5° 36 0 East

- Area of El Outaya: 40908 hectares 409.08 km²
- The climate of El Outaya: Hot and Dry Desert Climate (Köppen Classification: BWh
- Altitude of El Outaya: 253 m

3 Presentation of the experimental site

Three stations were chosen for the work

Station 01 : the CAZDA CONSIDER company in Biskra The experimental pivot are located in A pivotal 05 unit 01 was exploited for 4 years,

Geographic coordinates : **34°56°19 N 5°35 35 E 203m**

Station 02: the CAZDA CONSIDER company in Biskra The experimental plots are located in A pivotal plot 06 unit 01 was exploited for 4 years

Geographic coordinates :**34°56 34 N 5°35 05 E 202m**

These two stations were chosen to compare the intensity of the evolution of salinity in the with the use of the same water qualities.

Figure 23 Location of the pivot site (Google map)

3.1 The geographic location of the experimental site CAZDA

The trial was conducted during the 2021 at the CAZDA CONSIDER company in

Biskra The experimental plots are located at “Dris Amor farm” south of the commune of L’Outaya (about 5 km).

They are located north of Biskra (about 16km), The geographical coordinates of this site are:

- X=34°58057 ' N

- Y=005°36 939'E ,
- Z= 205 m

3.2 Thematic maps

Creation of thematic maps by (ARCGIS 10.1 software,)

Thematic mapping of variables with spatial structure can be done by the thematic maps of different settings studied. We took a total of 49 samples for each pivot, and for sting four variables which are Hydrogen Potential(pH) Electrical conductivity (EC) Total limestone ($CaCO_3$) Determination of active caclcair so we get a total of four maps to four different variables for each pivot.

4 Physic-chemical analyses of water

Sampling is essential and sensitive to obtaining accurate output. Forthe water analyses, water should be sampled in clean containers, rinsed several times with water for analysis, then sealed tightly. Analyses of key physical-chemical parameters were conducted to determine the water's characteristics.

4.1 Water sampling

Experimental techniques

To carry out the physico-chemical analysis, we have put at our disposal the central laboratory of the Centre Recherche Scientifique and Technique Arid. Regions(CRSTRA) Biskra.

4.2 Physic -chemical parameters of water

4.2.1 Hydrogen Potential (pH)

The pH is the co logarithm of the hydrogen concentration and represents the acid or alkaline character of a water mass. acid or alkaline character of a water mass.

4.2.2 Electrical conductivity (EC)

The mineralization of water occurs through water-rock interaction phenomena passing through different physical-chemical processes and/or mixtures between different types of water. The chemical composition of natural waters is the combined result of the chemical composition of the precipitations that reach the ground and the reactions with the minerals present in the bedrock (Kamagaté, 2006). Conductivity is a measure of The property of water to conduct electric current, which depends on the concentration of dissolved salts. The measurement of conductivity gives an idea of the total mineralization of a water, (Table.FAO29T).

4.2.3 Major-cations

Calcium (Ca2+)

The presence of calcium results from the crossing of waters to carbonate formations. ThenThe carbonic dissolution that follows is favored by the carbonic gas coming from the at0mosphere and the soil.To determine the calcium hardness, a variant of the complexometric method is most often used. EDTA is used in the presence of NaOH at pH =12, The colored indicator is murenide. The magnesian hardness is deduced by the difference between total hardness and total hardness and calcium hardness.

Magnesium (Mg 2+)

Second element intervening in the total hardness of water, these cations come from the dissolution of magnesian rocks of gypsum and ferromagnesian minerals These cations come from the dissolution of the magnesian rocks of gypsum and ferromagnesian minerals and especially from the solution of dolomites and dolomitic limestones.To determine the calcium hardness, a variant of the complexometric method. EDTA is used in the presence of NaOH at pH = 12 ;the colored indicator is murenide. The magnesium hardness is deduced by difference, total hardness total hardness and calcic hardness .

Sodium & Potassium(Na^+,K^+)

Sodium and potassium are always present in natural waters in variable proportions. variable proportion. Sodium can prevent the leaching of geological formations rich in NaCl in NaCl; potassium is much less abundant than sodium, rarely present in water. The cations Na + and K + cations are determined by flame emission photometry (JENWAY FP7). In order to perform the determination of sodium, the standard solutions are prepared by dilution from a stock solution of NaCl at 1000 mg Na from a stock solution of NaCl at 1000 mg Na+ /l ; For the determination of potassium, the standard solutions are prepared by dilution from a stock solution of KCl at 1000 mg K + /l.

4.2.4 Major-anion

Bicarbonates ($HCO3^-$)

They come from the dissolution of carbonate rocks according to the CO2 tension, the temperature, the pH of the water, and the lithological nature of the terrain crossed. The bicarbonates are the result of the physicochemical balance between the rock, the water and carbonic gas, according to the following general equation:

$$XCO_3^-(roche) + CO2 + H2O \rightarrow X^{++} + 2HCO_3^-$$

Chloride (Cl^-)

The waters too rich in chlorides are laxative and corrosive (Humbert and Pomier, 1988; Tarik, 2005). The concentration of chlorides in water also depends on the terrain crossed.

Sulfates ($SO4^{--}$)

Sulfates are always present in natural water. Their presence in water comes from gypsum formations, the slight solubility of CaSO4 with gypseous past and industrial wastewater. To determine the content of SO4 in the water samples, we opted for the

nephelo metric method, using a Spectrophotometer DR 5000 (HACH) at a wavelength of 600 nm for a suspension obtained by the reaction of sulfates with barium chloride.

4.3 Sodium Adsorption Ratio (SAR)

In the study of sodization mechanisms, the Riverside School at the USDA (1969) uses a precise parameter to define the composition of the soil solutions or salt sheets.

It is the "Sodium Adsorption Ratio" RAS (Mathieu and Pieltain 2003). SAR is calculated by the following expression:

$$SAR = \frac{Na^{+}}{\sqrt{(Ca^{2+} + Mg^{2+})/2}}$$

Where Na+, Ca++ and Mg++, represent concentrations in milliequivalents litre in the soil solution or irrigation water. RAS provides guidance on the risk The risks are low if the SAR < 10, average if SAR is included between 10 and 18, high if SAR > 18 and very high if SAR > 26. There are several relationships empirical evidence between RAD and PSE. The most classic and most used relationship is that proposed in 1954 by L'U.S.S. L on the basis for measurements on 59 different soil types.

4.4 Piper diagram

The Piper diagram (Figure 14) is used to characterize the geochemical facies of waters. This characterization is based on calculations of relative proportions of the different cationic and anionic species analyzed. This diagram is formed by a 1st triangle for cations, a 2ed triangle for anions and a third triangle for anions. triangle for the anions and a diamond cut in water family. The elements considered are (Ca2+, Mag2+, Na+, Ka+) for the cations and (HCO3-ClNO3+SO42-) for the anions. In the diagram, the relative concentration in meq/l of each element is calculated to place the points on the triangles which are then projected on the diamond. This concentration is defined by the proximity of the projection points to the different vertices or poles. The projection in the parallelogram of the points placed in the triangles of anions and

cations, classifies the solution into facies according to the predominant ions (Allassane, 2004)

Figure 24 Diagrammes de Piper vierges

5 Physic-chemical analyses of soil

Soil sampling was carried out at randomly selected points. Samples were taken from both (0–30cm) and. A total in each pivot were packaged in plastic bags to be brought to the laboratory, then air-dried and sieved at 2 mm (Aubert 1978). Chemical analyses were carried out by the Soil Science Laboratory of the Biskra Technical Research Center, and (ITDS Laboratory)also(CRSTRA Laboratory)

5.1 Soil samples

The samples were taken at a depth of 0-30 cm with a distance of 30 m between each sample and were collected in labeled plastic bags that bore the date, the number of the site, and the type of soil. A total of 49 samples were taken from each pivot.

The process that the soil passed through before the analysis was dried in the open air

; After the drying comes the grinding and finally the sieving with a sieve of 2 mm

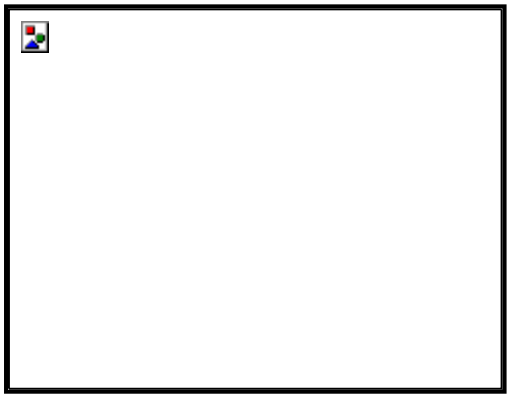

Figure 25 Location of plots at unite 01

5.2 Granulometry

Granulometry concerns the determination of the percentage of constituent elements (clay ,of a sample of the studied soil in order to know its texture (Randrianampy, 1997 (Rabefiraisana, 2015) **,** According to (AFNOR, 1996), the granulometry was determined by following the standard NF X31-107 by Two complementary methods (fractionation by dry way then gravimetric separation This allows gravimetric separation up to 2µm by sedimentation of particles constituting the fine soil.To classify the particles according to their diameter, or by sieving, standard AFNOR NFX31-101; the principle of this manipulation consists of pouring a sample of the ground of a classifies sieves in ascending order of openings from bottom to top. The weight of the Refusals of the sieve make it possible to trace the curve granulometry.

5.3 Total calcair (CaCO3)

Many soils, especially those developed in arid and semi-arid climates contain more or less important quantities of calcium carbonate (CaCO 3). This calcium carbonate is commonly known as limestone. A calcareous soil is a soil which contains a part or on the totality of the profile of CaCO3 The presence of limestone in the fine particles(coarse fraction) or in the pebbles (2mm).Calcareous soils can be classified according to the Total Calcium (CaCO 3) interpretation scale Tableau N°08 (Baize, 2000).

5.4 Organic matter (organic carbon)

Organic matter is the basis of soil fertility, i.e. it improves both its physicochemical and biological stability.physical-chemical and biological qualities (Bourgeat, 1972 in Rabefiraisana, 2015). The Organic matter plays an important role in the overall functioning of thesoil through its physical Its physical, chemical, and biological components, which define the notion of fertility (Huber and Schaub, 2011). The standards for interpreting the concept of soil fertility .

5.5 pH measurement

According to AFNOR (1996), pH is one of the most important physicochemical characteristics of soils, because speciation, and therefore the mobility and bioavailability of chemical elements, are related to its value. The pH measures the concentration of H+ions in the water. It reflects .The pH measures the concentration of H+ ions in water, and thus reflects the balance between acid and base on a scale of 0 to 14. It is measured by a pH meter on a soil/water solution=1/2.5 (Dudka and Driano, 1997) .All the elements in the soil are more assimilable at a pH close to neutrality. It is impossible to manage the chemical fertility of a soil without managing the pH at the same time (Rabefiraisana, 2015)

5.6 Measurement of electrical conductivity

According to Clement and Françoise (2003), the electrical conductivity of a soil solution is an index of the soluble salt content of the soil, i.e. its degree of salinity. This soil indexes the contents of soluble salts in this soil, i.e. its degree of salinity, measured in mili-Siemens per cm (mS/cm). It is measured directly by the use of a device called the conductivity meter.

5.7 Determination of active limestone

The method used is DROUINEAU- GALET this method is only suitable for soils containing less than 2% MB. For the determination of active limestone, we use the property of limestone to combine with oxalates to give insoluble calcium oxalate. The excess oxalate solution is then measured by a solution of potassium permanganate in a sulphuricmedium.

5.8 Chlorides

The Cls ions are measured using the MOHR silver metal method. They precipitate as AgCl2 in the presence of AgNo3.

5.9 Cations Ca++ and Mg++

Soluble After dilution of the extract 1/5 cations are determined by the flame spectrophotometer by atomic absorption for the cations Ca++ and Mg++.

5.10 Sulphates

Sulfates are determined using the gravimetric method, which, despite its age, remains valid for SO4-rich soils. It is still considered a reference method (RODIER, 1976).

6 Statistical processing and analysis of results software

The software used for the statistical processing and analysis of the results is Exel . Water test results processing software For the analysis of the water analysis data, we used the software Diagrams of the Avignon Hydrogeology Laboratory, Roland SIMLER,

Chapter 04:

Results and Discussion

In this part we will present all the results of parameters measurements previously detailed in the equipment and method part, and which concerns the evolution of the chemical state of the soils of the plots and their irrigation water. The purpose of the analyses is to assess the physico-chemical quality of water in Biskra lotaya (Casda).

1 Physico-chemical Analyses

The characterization of watersheds for irrigation concerns essentially the analysis of basic parameters (pH, temperature, conductivity). , major ions. Cations (Ca2+, Mg2+, K+, Na+) and anions (Cl−, CO3−, HCO3− ; SO42−), . The analysis methods used for the determination of physico-chemical parameters .

1.1 Physico-chemical parameters of water

1.1.1 physical and chemical analyzes

The table below summarizes the accepted values of the various elements present in the irrigation water and the results of our analyzes. Thresholds can be higher when unwanted elements accumulate in the soil and this negatively affects the quality of soil and for that this results are desirable values especially when we used the same water consistently.

Tableau 6 Values for various elements analysed in irrigation water

		Cations (méq/l)					Anions (méq/l)			
	EC (dS/m)	Ph	Na	Ca	Mg	K	CO3	HCO3	Cl	SO4
lotaya	4,16	7,82	24,96	33	36,6	0,46	0,8	2,4	5,58	30,9
Standards(maximum allowable value)	<3ds/m	6,5-8,5	40	20	5	2	-	50	10	20

From the table we notice that the Hydrogen potential (pH) obtained is 7.82 this is compliant with Algerian standards which set pH values between 6.5 and 8.5 (basic alkaline soil) and for the electrical conductivity value are 4.16 ds/m which does not comply with the Algerian stan dard indicating a limited value According to the classification of waters (USDA, 1954), the waters of the experimental site are classified as very salty waters CE >4 ds/m

Calcium value found is 33 meq\l. This result does not comply with Algerian standards which recommend a maximum concentration of 20 meq\l, it is generally the dominant element of irrigated water

Magnesium ion origins are comparable to those of calcium, they come from the dissolution of carbonate formations with high magnesium content, confirming the work of Touati (2017).

In the water points analyzed (see Figure 01), 36.6 meq/l megnesium exceeds the standards according to (Weksota 1997) which are 5 meq/l.

The origin of sodium in water is mainly linked to the leaching of deposits evaporative and this by phenomena of leaching, evaporation and base exchange(Sais and Touati, 2017).In the water point analyzed 24.96 meq/l of sodium (Figure 01), indicates that there is no problem according to FAO standards 40meq/l.

The values of this parameter in the water studied 0.46mg/l (Figure 01). They are within the standards according to (wescott1997) 2meq/l The major anions

The chloride ion has different characteristics from those of the other elements,it is not adsorbed by geological formations, does not easily combine with chemical elements, and remains very mobile. The chlorides encountered in large quantities groundwater come from the dissolution and leaching of siliceous soils. In the water point analyzed (Figure 01) we fond

5.58meq/ according to water Westcott standard (10meq/l).

The presence of sulfate ions in water is linked to the dissolution of the formations of the sulphate:

$$\left[\quad CaSO_4+2H_2O = Ca^{2+}+ SO_4^{--}+ 2\ (H2O) \quad \right]$$

The sulphate values found are 30.9 meq/l, they remain below the maximum concentration decreed by the Algerian standards 20 meq/l

The results of analyses of the physico-chemical parameters of the CAZDA waters show high values of electrical conductivity .

It has very high correlation significant linked, mainly, to the high presence of calcium Ca++, chlorides Cl- , sodium Na+ and Mg++ magnesium. Water is strongly linked between the evaporative elements (Na+, Cl- , SO4--, Mg++ and Ca++) and mainly due to the nature of the materials salinization of these waters. and The work carried out by (MERDACI Samir2019) in the same experimental site of loutaya Casda show a EC >4 ds/ and pH =7.5 with some Cations (meq/l) Anions (meq/l) values close to what we found in our results

Water classification

SAR

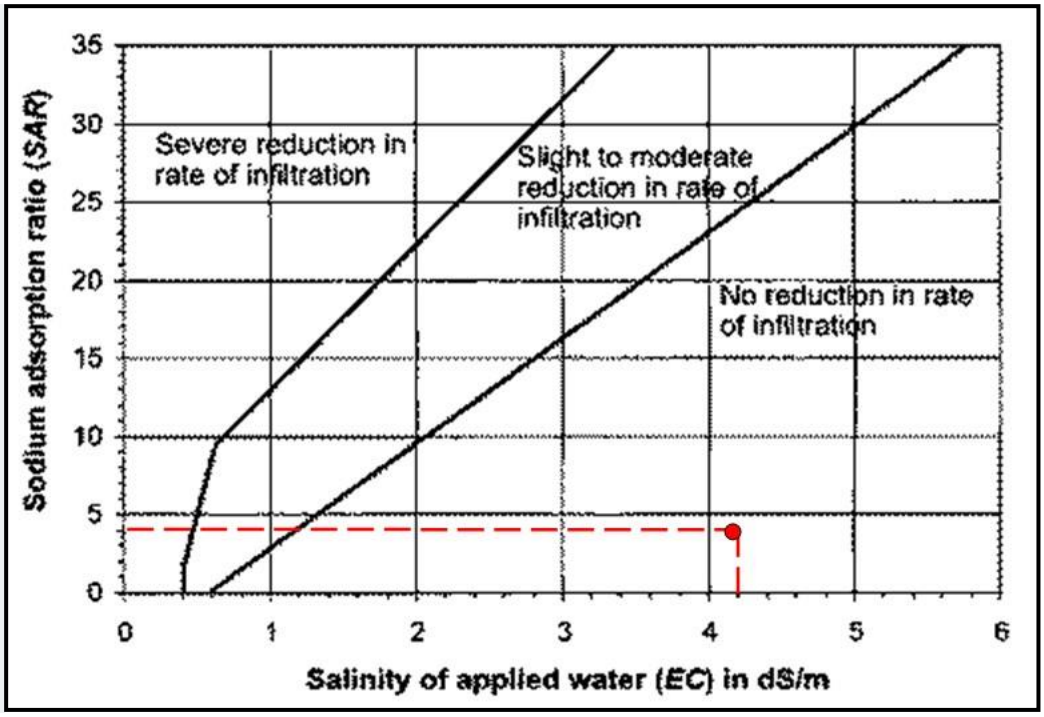

Figure 26 diagram expressing the relationship between SAR and salinity index

Classification of irrigation waters according to PIPER

According to the Piper diagram (Figure 27), The waters of this DRILLING have 2 high composition on hydrochemical ,Sodium chloride. Dominant magnesium calcium sulphate.

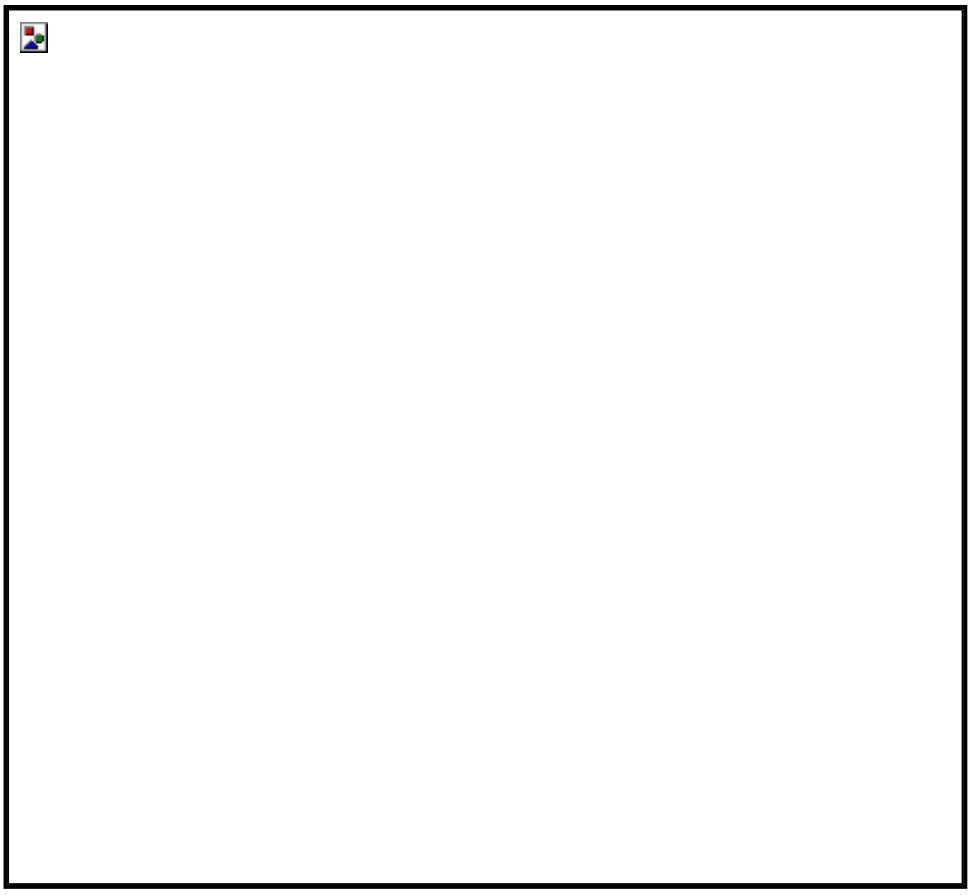

Figure 27 Piper diagram of irrigation water used

1.2 Physic-chemical parameters of soil

According to Rabefi

raisana (2015), soil testing is a procedure aimed at characterizing soil composition and physical and chemical properties. Today, soil is seen as a living entity. It is no longer just an

accessory or filter to adapt to the quality of the water it wants to grow. Soil analysis should be carried out in order to know the degree of fertility.

This part addresses a range of analyses that allow us to know the physical and chemical properties of the previously studied soil in grain under a pivotal system. This allows us to discuss the results obtained at the table below.

Soil texture of the experimental site

The soil has a silty clay texture having the following characteristics

echantillons	*Sabler (%)*	*Limon %)*	*Argile %)*	*Observation*
Loutaya p05	22	43	35	**sol limoneux argileux**
Loutaya P06	24	44	32	**sol limoneux argileux**

The characteristics of this type of soi:. It's heavy soil and is difficult to work on.And since it's a charged soil it has the ability to install metal materials, and that's what gives it an Import water retention cap

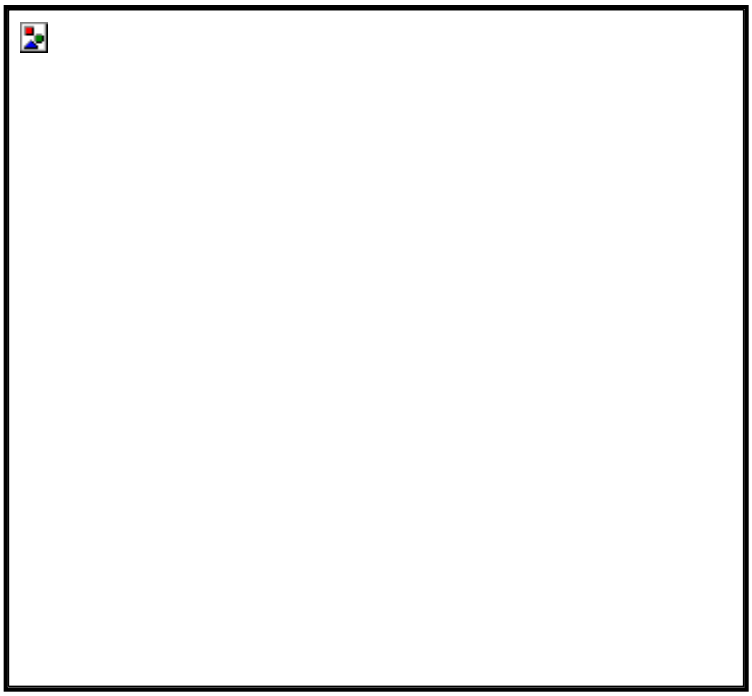

Figure 28 Textural triangle (Clement and Francoise, 1998)

1.2.1 Pivot 5

In the following table 02 shows the results of physico-chemical soil analyses of pivot 05

Tableau 7 Physic-chemical soil analyses of pivot 05

	EC (mS/cm)	pH	Active calcaire%	Total calcaire%	MO%	CEC (méq/Kg)	Cations (méq/l)				Anions (méq/l)			
							Na^+	Ca^{++}	Mg^{++}	K^+	$CO3^-$	$HCO3^-$	Cl^-	$SO4^{--}$
loutaya P2C2	2,75	7,91	27	51,3	0,89	16,6	65.925	14.5	21.5	2.025	0	7	21.6	40.75
loutaya P2C6	3,06	7,91	22	50,53	3,06	19,588	61.225	16	16	1.775	0	5	28.4	30.25
loutaya P2V1	4,07	8,15	18,5	48,69	3,11	20,78	68.275	17.25	35	2.75	0	7	32.4	51.25

the electrical conductivity values in the soil samples recorded in (Table 02)are between 2.75 and 4.07 . They reveal a strong ionic strength. These high values indicate the presence of soluble salts and According to the values of this three samples are classified as a very salty soils

According to the values of the pH recorded in table 02, it appears those values between 7.71 and 8.15. The soil presents an alkaline pH. However, the highest value was recorded in P2V1

with 8,15 classified as very basic soil when the others soil samples are moderately basic. We note that the pH and EC values increase simultaneously.

An ionic balance was established to determine the concentration of cations Na+, K+, Ca++, Mg++ and anions HCO3-, CO3-, SO4--, Cl

The soils analyzed are characterized by a moderately low organic matter content between 0.89% and 3.11% and these results enable us to classified this soils into tow categories wish is very poor (P2C2) and medium (P2C6 and P2V)

The soils analysed are classified into two classes; highly calcareous soil for the third samples (lotaya P2V1) 48.69% and the remaining two samples have a (very strongly calcareous) concentration of 51.30% and 50.53%

The three soil samples studied have a very low rate of CEC (16.606 meq kg 19.588 meq kg;20.780 meq kg) <60 meq kg

The ionic composition for the three samples, has a calcium and magnesium dominance for the exchangeable cations, and a main sulphate dominance for exchangeable anions for the three soil samples.

1.2.2 Pivot 06

Tableau 8 Physic-chemical soil analyses of pivot 06

	EC (mS/cm)	Ph	activc alcaire %	Total calcai re%	MO %	CEC (méq/Kg)	Cations (méq/100g)				Anions (méq/100g)			
							Na^+	Ca^{++}	Mg^{++}	K^+	CO_3^-	HCO_3^-	Cl^-	SO_4^{--}
loutaya P2C2	5,01	8,15	17	50,04	1,22	17,799	90.6	25	29.5	2.3	0	4.5	37.2	66.5
loutaya P2C6	5	7,8	24,5	40,86	3	18,097	81.2	25	19	2.95	0	5.5	30	40.75
loutaya P2V1	4,2	7,71	23,5	47,82	0,44	17,202	100	17.5	37	2.225	0	5.5	36	79.375

The electrical conductivity values of the soil samples recorded in Table 2 are between 5.01 and 4.2 . They reveal a strong ionic strength. These high values indicate the presence of soluble salts wish mean that this soil classify in a very salty soils categories

According to the values of the pH recorded in table III.2, it appears that these values are between 7.71 and 8.15. The soil presents an alkaline pH

and for the organic matter content The three samples have a three different classification which are: very poor (P2V1) , poor (P2C2), medium (P2C6)

The soils are classified into two classes very strongly calcareous soil for the first samples (lotaya P2V1) 73.04% and the remaining two samples have a (strongly calcareous) concentration of 40.86% and 47.82%

The all soil samples studied have a very low rate of CEC (17.799 meq\ kg 18.097meq\kg ;17.202meq\ kg) less than 60 meq kg.

The ionic composition , has a calcium and magnesium and sodium dominance for the exchangeable cations, and a main sulphate dominance for exchangeable anions , also chlorine and this for the all soil samples.

Comparaison

In our comparison of analysis values results we obtained in the two pivots (06 and 05) , we notice that there is a similarity between them. The two are not similsr in their physicochemical composition. Indeed, both present a soil of alkaline pH with high values indicate the presence of soluble salts under classification: as a very salty soils for both parties .

with regard to the results of the analyses Total limestone and active limestone almoste identical because we noticed that in both cases the concentration of limestone active was almost similar and for the results of the Total limestone analyses we concluded that the two pivot samples contained two different classification : highly calcareous and very strongly calcareous for the pivot 05 and very strongly calcareous and strongly calcareous for pivot 06 .

While the results of the organic matter analyses show that the three samples pivot 06 has a three different classifications :very poor in organic matter , poor in organic matter , medium and for the pivot 05: has a two different classifications :very poor in organic matter and medium

While in both pivot 05 and 06 has the similar to CEC classification results : very low rate of CEC .

On the other hand, we observed the ionic composition have a similar values of the ionic balance for the anions except the sulfate there is an increase in its concentratoin in the pivot 06 also with an increase in the results of analysis of Na+, Ca++, Mg++

After the findings of the test soil conducted by SIDDRA demonstrate a value that is similar to that discovered in our research


siddra
Système Intégré d'analyse et de Recommandation de Fertilisation

Référence N°: 8938 21/05/2018
Bulletin edité le: 24/06/2018

FERTIAL
Les Fertilisants d'Algérie

Données du consultant
CAZDA CAZDA
El outaya 07100 El Outaya (Biskra)

DONNÉES DE L'EXPLOITATION, PARCELLE ET CULTURE

Propriété:	P	*Culture:*	BLÉ /DUR/ Gta dur
Parcelle:	Lz11	*Production:*	60 q/Ha
Cadastre:	Polygone 0 Parcelle 11	*Type:*	Irrigation extensive
Localité:	El Outaya	*Surface:*	30 Ha
C.P.:	07100 (Biskra)	*Identification:*	

Résultats de l'analyse du sol

Fertial Laboratoire agronomique
BP 3088 Route Des Salines Annaba
Tél: 038.53.96.10 / Fax: 038.53.93.42

échantillon n° T-28910

Code-barres

Sable 16% Limon 40% Argile 44%
Texture: Argileuse

Conductivité (1/5 mS/cm)	1,8	Très salé
pH eau (1/2.5)	7,92	Alcalin
C/N	6,2	Faible
	%	p.p.m.
Carbonates	37,02	370200,00
Calcaire actif	-	-
Matière organique	0,96	9600,00
Azote Total	0,09	900,00
	meq/100gr	p.p.m.
Phosphore (Olsen)	0,03	10,2
Potassium échangeable	1,1	418,3
Magnésium échangeable	4,2	510,7
Calcium échangeable	37,8	7569,1
Sodium échangeable	4,1	936,0
C.E.e (mS/cm)	12,7	Très salé

pe Villar Mir –Route des Salines- ANNABA

Figure 29 SIDDRA soil tests (SIDDRA;2018)

Thematic maps

The study of the spatial variability of the soil parameter was carried out in two stations LOutaya casda (station 01) pivot 05 (station 02) pivot 06 unite 01 In the stations the central pivot were exploited for 04 years of durum wheat the Sampling was carried out over a depth of 0 to 30 cm in the tow pivot studied with a number of 49(7*7) samples The soil results revealed the distributoin of concentration in the surface of the tow pivotnumber of 98 samples for the too pivot

Table summarised analysis results of the two pivot

	CE	CT	PH	CA
MAX P6	6	53.74	8.17	29.7
MIN P6	2.36	29.83	6.33	6.33
AVEREGE P6	3.70477551	42.78469388	6.988571429	14.73469388
MAX P5	6.05	50.69	7.91	28
MIN P5	0.29.	32.73	5.95	7
AVEREGE P15	3.678369388	43.43961735	6.978464286	15.7

Thematic maps to the distribution of active calcair in pivot 05

- **Active calcair**

The map (Fig.30) shows a variable concentration of active calcair in the pivot 05, it ranged between 6.97% to 28.65. % The highest values are found in the southeast of the parcel from 19.985% to 28.65% that shown in dark red color as we go to the west the color fades

evidence of a lack of active calcair concentration which revealed a low to medium amount of this component.

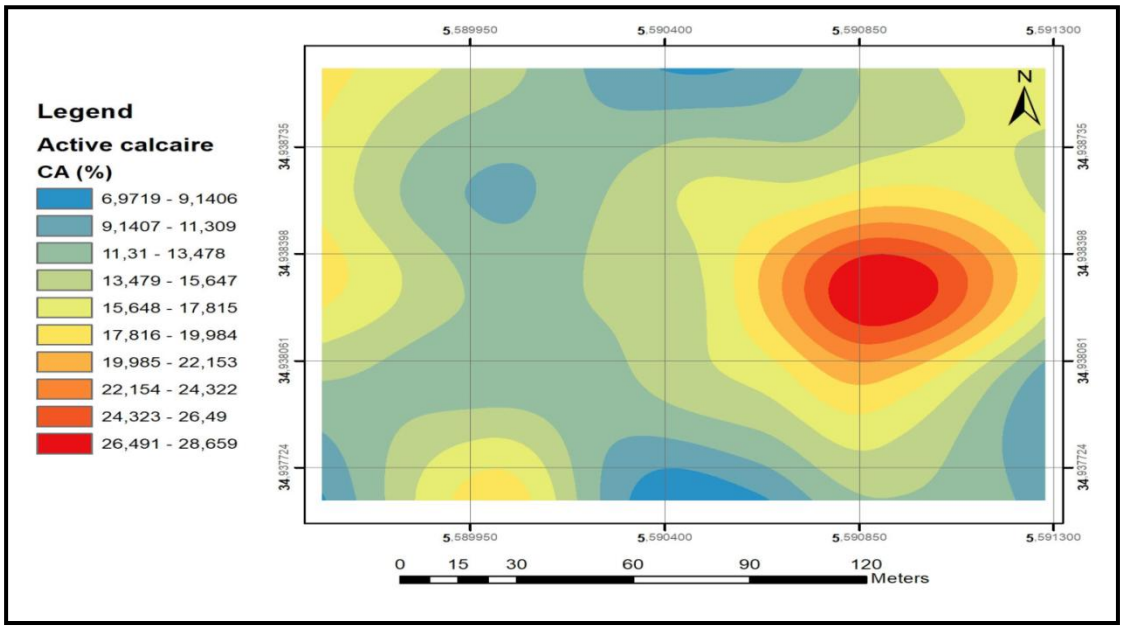

Figure 30 Map expresses the distribution of active calcair in pivot 05

The map (Fig.31) shows a concentration of active calcaire in the pivot 06, , and the arise from 6.33% to 30% The highest values are found in the northeast and in the south of the parcel varies from 22% to 30% that shown in dark red color .

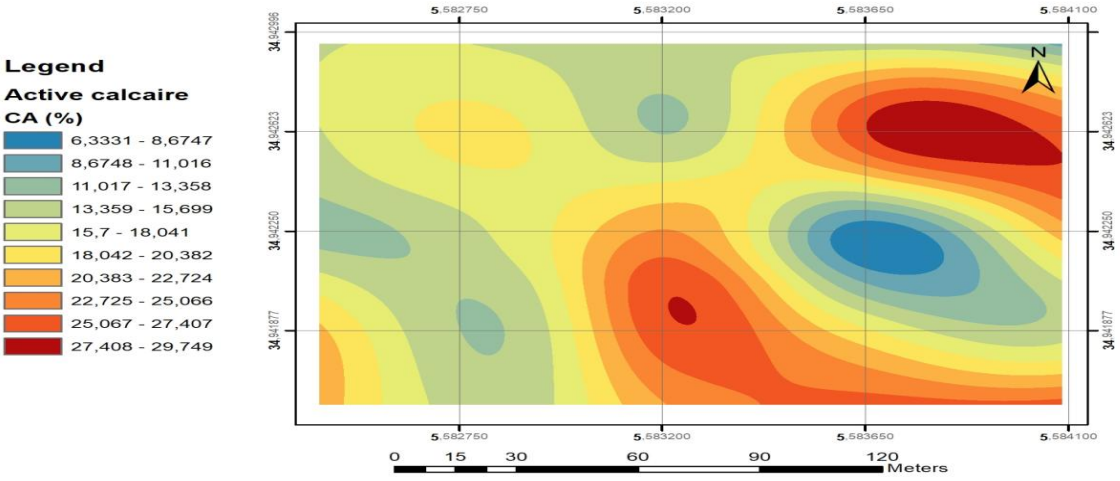

Figure 31 Map expresses the distribution of active calcair in pivot 6

Comparison

Comparing between the two Thematic maps (Fig. 30 and 31), we notice a difference in the Ca concentration between these two notice a big between these two pivot, the noted the

following: The Ca in the pivot 6 higher than that of pivot 5 as an accumulation in the northeast and in the south the opposite for pivot 5 dominates mainly blue gradients indicating a lack of active calcair concentration .

- **Total calcair**

The map (Fig 32.) shows a concentration total calcair in the pivot 05, , and varies from 32.74% to 50.69 % . The highest values are found in the northeast and the centre to the south west of the parcel varies from 45.109% to 50.693% (highly calcareous) according to Scale of salinity (Aubert, 1978) .

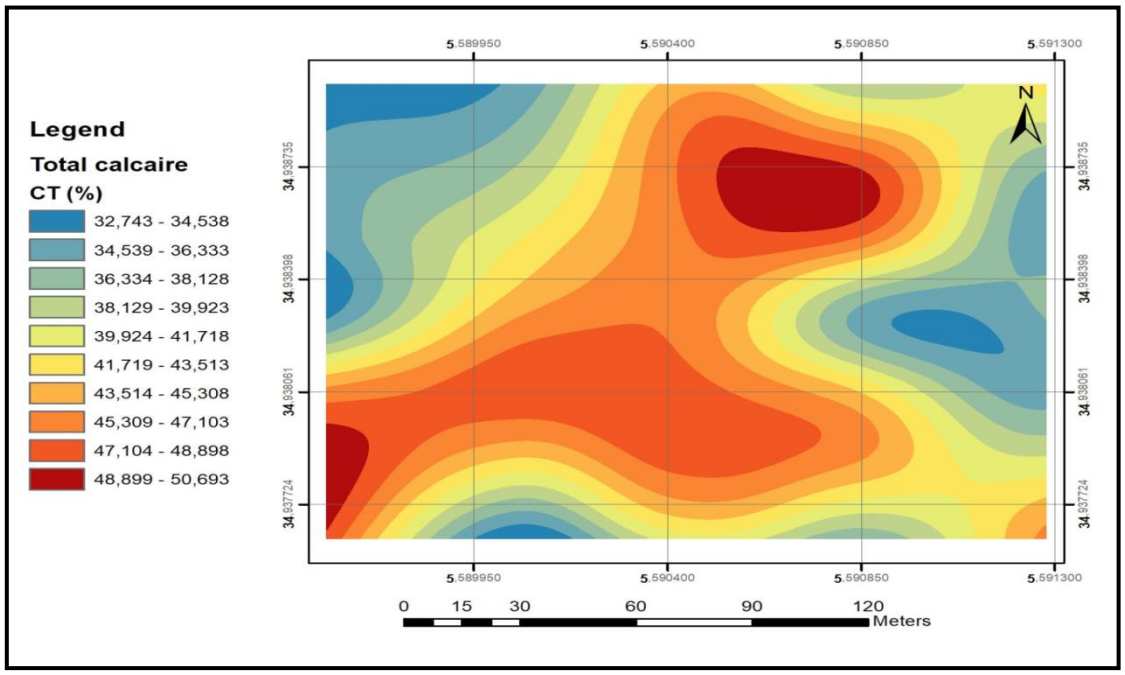

Figure 32 Map expresses the distribution of total calcair in pivot 5

The map (Fig 33.) shows a concentration total calcair in the pivot 06. the values vary from 29.83% to 53,74% which means the soil is salty. The highest values are found in the southwest and the centre of the parcel varies from 29.83% to 53.74% and in the edge of the map (highly calcareous) to (very strongly calcareous) according to Scale of salinity (Aubert, 1978) .

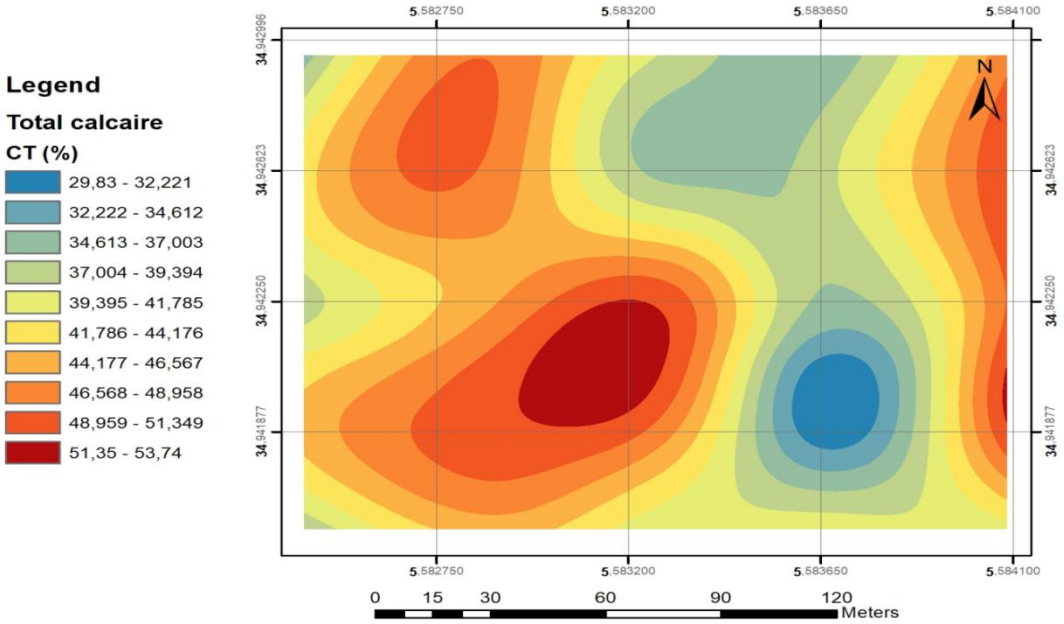

Figure 33 Map expresses the distribution of total calcair in pivot 6

Comparison

We notice a difference in total calcium concentrations between the two pivots (figure32 and 33). In pivot 5 the lowest concentrations are spread over the edges of the map while the largest concentrations are present in the southwest and the centre ; conversely, in pivot 6 the accumulation is in the northeast and the centre to the south west with high concentrations of calcareous (soil classes). We note that in both maps there is a high concentration, which means the soil of pivot 5 and 6 counties (highly calcareous) to (very strongly calcareous) according to the scale of salinity (Aubert, 1978).

Discussions

The analytical results, show that the total limestone content varies from 32.74% to 50.69 % in the pivot 05 , and in the soil of the pivot 06 with a variation of 29.83 % 53.74 . In both pivot The soil changed from moderately calcareous to strongly calcareous

This decrease may be the result of leaching of limestone from the surface horizon to the depth surface horizon to the depth following irrigation.

- **Electrical conductivity**

In the next map (fig 34) the electrical conductivity varies from 0.3 dS/m to 6 dS/m, witch the 95 % of this map distributed from 2.6 dS/m to 6 dS/m means the soils is salty. The highest values are found in the southeast of the parcel and vary from 3 dS/m to 5 dS/m (very salty soil) according to the scale of salinity (Aubert, 1978)

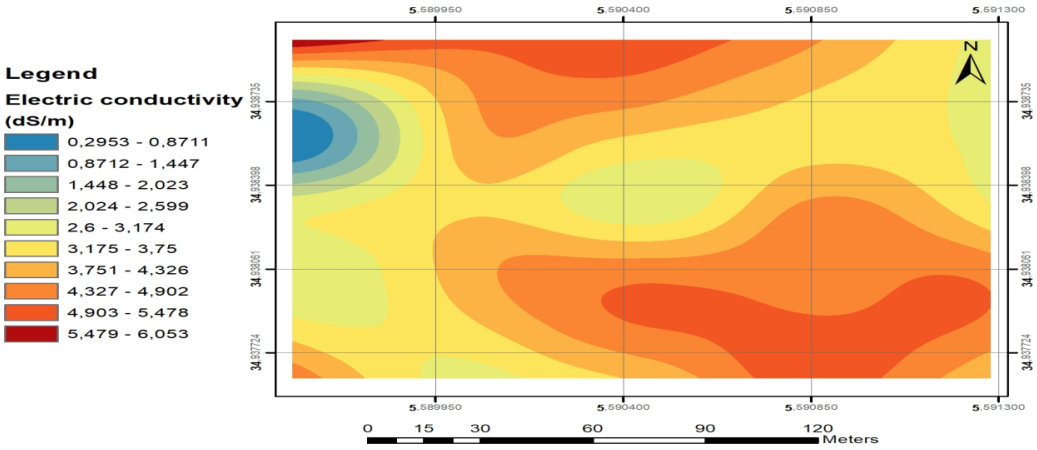

Figure 34 Map expresses the distribution of EC in pivot 5

The map (Fig 35.) shows a concentration high salinity or electric conductivity in the pivot 06, that is varies from 2.36 to 6 dS/m, which means the soil is salty. The highest values are found in the southeast and in the northwest of the parcel varies from 4 dS/m to 6 dS/m (very salty soil) according to Scale of salinity (Aubert, 1978).

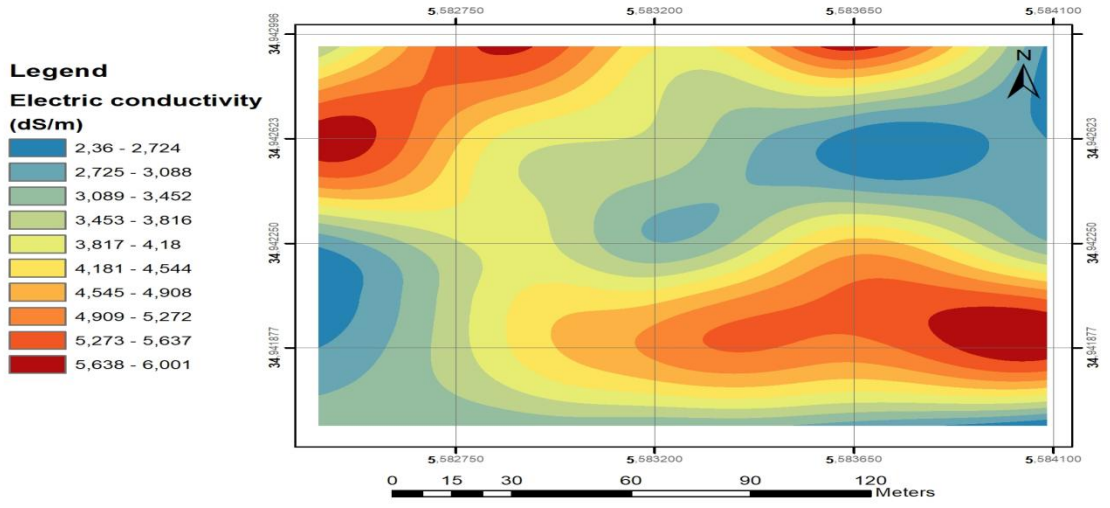

Figure 35Map expresses the distribution of EC in pivot 6

Comparison

According to thematic maps of the two pivots (figures 34 and 35), there is a difference in the distribution of the electric conductivity. In the pivot 5, the lowest concentrations are distributed across the map's edges, while the largest concentrations are present in the southwest and the center. In contrast, the pivot 6 has an accumulation in the northeast and the center to the south west with high concentrations of salinity material. ding to Scale of salinity (Aubert, 1978).

- **Hydrogen potential**

The map (Fig 36.) shows a concentration of Hydrogen Potential(pH) pivot 5, and varies from 5.97 to 7.91, The highest values are in the northeast and in the southeast of the pivot varies from 7.25 to 7.917 and that mean the soils (moderately basic) and (very basic) according to Scale of (Aubert, 1978).as we head into the middle the orange colure decreases and vary .

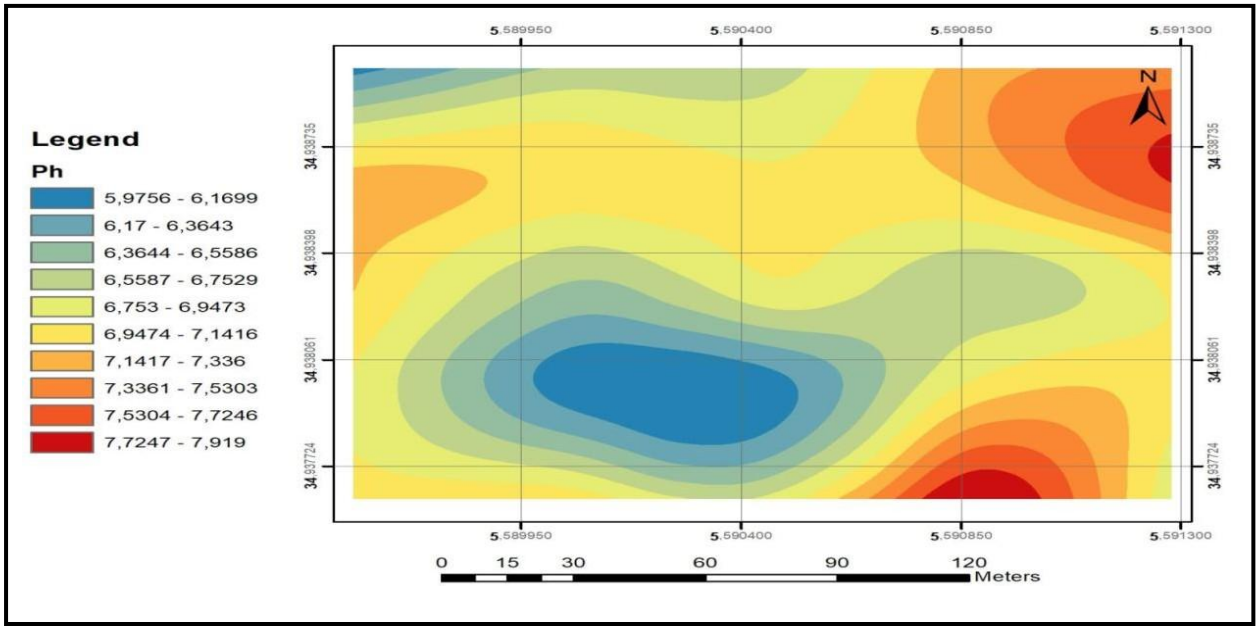

Figure 36 the distribution of Hydrogen potential in pivot 5

The map (Fig 37.) shows a concentration of Hydrogen Potential(pH)pivot 5, , and varies from 5.97 to 7.91, The highest values are in the northeast and in the southeast of the pivot varies from 7.25 to 7.917 and that mean the soils (moderately basic) and (very basic) according to Scale of (Aubert, 1978).as we head into the middle the orange colure decreases and vary between 5.91 and 6.55 moderately acidic to natural

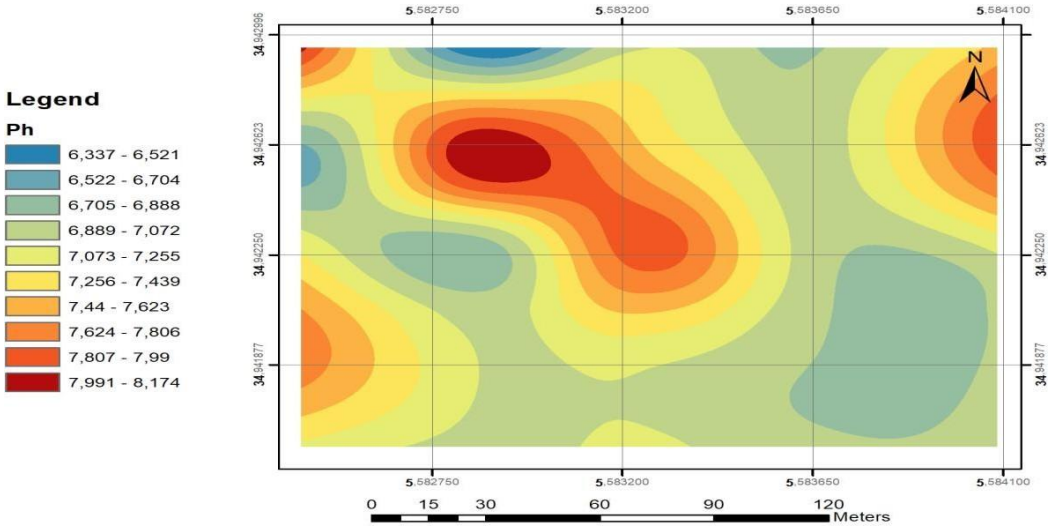

Figure 37 the distribution of Hydrogen potential in pivot 6

comparison

Conversely, in pivot 6, the accumulation is in the northeast to the south west with large conce ntrations of pH. In pivot 5, the lowest concentrations are dispersed around the boundaries of t he map, while the lowest concentrations are present in the Southwest and the center.
We see low concentration on both maps, and we also observe that the intersection of the two p ivots is not homogeneous on either map .

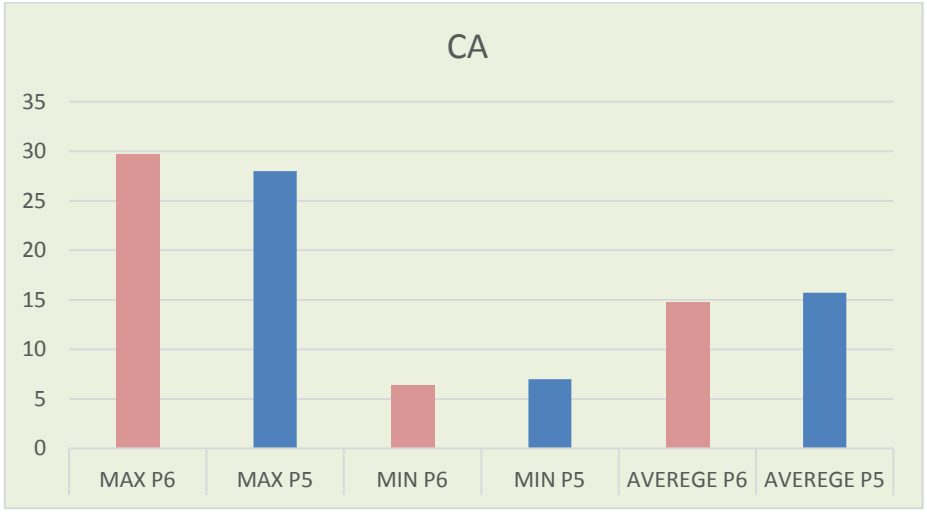

Figure 38 represent the evolution of the CA in pivot 5 and 6

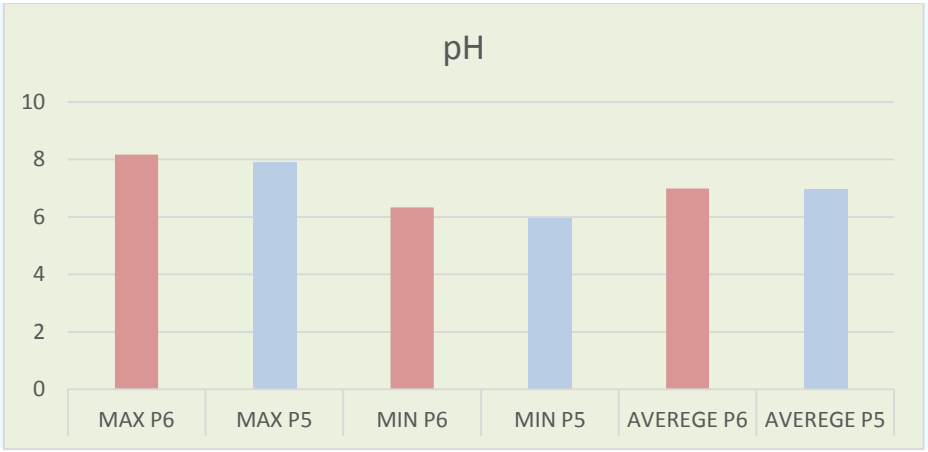

Figure 39 represent the evolution of the pH in pivot 5 and 6

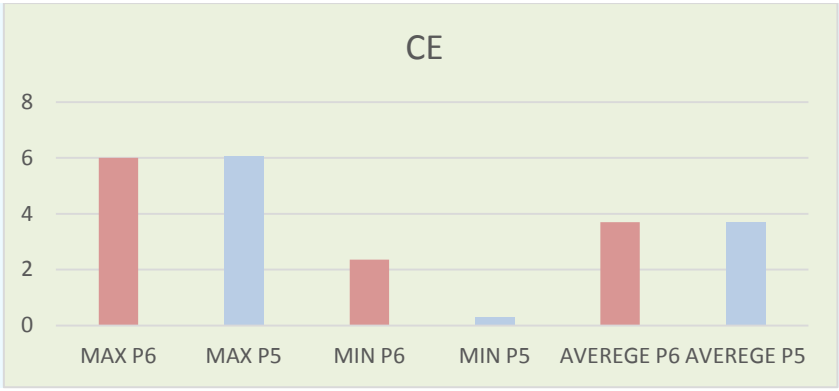

Figure 40 represent the evolution of the CE in pivot 5 and 6

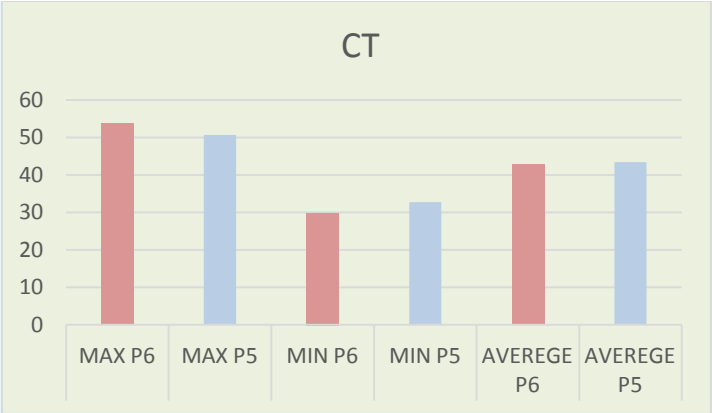

Figure 41 represent the evolution of the CT in pivot 5 and 6

based the results obtained in previous studies The graphical representation in Figure In the graph of the parametric characterization of the soil for the 2 sites, we notice that the averages

of the different parameters (Ce and Ph, CT, CA) are close in spite of the differentiation and the ranges between the minimum and maximum values.

For the Ce with 3.70 and 3.64 for pivots 1 and 2, we observe a difference reaching the 2 between the minimum and maximum value for both(5 and 6)

At the level of CT, the averages for the pivot 1 and 2 give the values 42.78 and 43.44, with a remarkable difference at the upper limit of the minimum and maximum interval. For the ph, we can take the averages to be similar with a difference of 0.01 between them. The only interesting difference this time is at the level of the lower limit between sites 1 and 2 with an increase reaching 3 for pivot 2.

Conclusion

The results of this study can be summarized as follows:

- The high climatic demand in arid zones, the sandy texture of the soil, the wind, and the shallow and relatively mineralized water table are therefore optimal

For both soil analysis and irrigation water analysis, the appearance of chemical profiles in concentrations of dominating ions in the soil solution is equivalent where The concentration of electrical conductivity in the tow pivot varied between 1 dS/m to 6 dS/m ..and the hydrogen potential varied between 6 to 8 close to the result obtained in water analysis with a ph of 7.82 and CE 4.1 dS/m

- The risk corresponding to the plots irrigated by pivots in our region is higher than the author with Wind Effect Climate Factors (as we see in our climate data)and the nature of the soil of our region based on the results represent in cart thematic that we have a soil (highly calcareous and very strongly calcareous a very salty soils) for both parties

- Using salty water for irrigation causes a phenomenon known as leaching of salts from the surface to the deep; in the absence of irrigation, these salts will increase due to evaporation

soil analysis, as well as the representation on a thematic map allowed us, from the standpoint of the problems we found, to suggest some solutions

-Verifying the region before planting Especially for sensitive crops

-Develop large-scale irrigation management in arid regions with the problem of water sanitization as in our region

-Improving water productivity in the salty soil

-The realization of the map of the distribution in concentration of the parameters that propose the problem of salinity and comparing it with the norms of resistance of the culture to improve and increase productivity

- effective intervention and propose appropriate solutions to those responsible improving soil and water productivity and preserving natural resources.

-The amount of salt in the soil that plants can tolerate varies with families, and species, but also the varieties considered. Salinization would therefore constitute One of the main factors responsible for the decrease in durum wheat of the hard in the coming years, being sensitive to salinity with poor product

Bibliographic references

1. ABDELHAFID Y., 2010- Cartographie de la salinité des sols par induction électromagnétique: cas de la zone est du périmètre irrigué de la Mina. Mémoire de magister, I.N.A., Alger, 102p. ABDESSELAM S., 1998 - Contribution à l'étude des solsgypseux au Nord-est du Sahara algérien: Caractérisation et genèse. Cas des oasis de Tolga (région des Zibans). Mémoire de magister. I.N.A., Alger, 147p.
2. Allassane. A 2004 Etude hydrogéologique du continental terminal et des formations de la plaine littorale dans la région de Porto-Novo (Sud du Benin) : identification des aquifères et vulnérabilité de la nappe superficielle.
3. ANRH (2011) Agence Nationale Des Ressources Hydrauliques Etude sur modèle mathématique du système aquifère de la région du Biskra.
4. Ashley, R., & Cashman, A (2006). Incidences du changement sur la demande à long terme d'infrastructures dans le secteur d'eau. OCDE-Organisation de Coopération et de Développement Économiques. Programme de l'OCDE sur l'Avenir. Les infrastructures à l'horizon, 2030.
5. Ayerset Westcot (1994)Bouhoun, M. D., & Brinis, L (2006).Étude de la dynamique des sels solubles dans un sol irrigué gypso-salin: cas d'une palmeraie de la cuvette de Ouargla. J. Algérie. Rég. Arides, Nspécial, p 17-20.
6. Banque mondiale (1988).Banque Mondiale, U. S. A. I. D. (1988). Coopération Suisse.
7. Bekkouch k, Bouammali, H., Ousslim, A., Bouammali, B., Aouniti, A., Al-Deyab, S. S et al Hammouti, B (2013). The anti-corrosion behavior of Lavandula dentata aqueous extract on mild steel in 1M HCl. Int. J. Electrochem. Sci, 8, 6005-6013.
8. BENBRAHIM F., BENSLAMA M., KEMASSI A., DAREM S., HAMEL I., CHIKHI F., HALILAT M. T., 2016- Evaluation de la durabilité dela céréaliculture sous pivot par l'étude de la salinisation du sol dans la région d'Ouargla. Ciência e Técnica Vitivinicola, 31(5), pp.107-123.
9. Benouniche, M., Kuper, M., Hammani, A., & Boesveld, H. (2014). Making the user visible: analysing irrigation practices and farmers' logic

to explain actual drip irrigation performance. Irrigation Science, 32(6), 405-420.

10. BENSAID R., 1999 – Les sols à accumulation gypso- calcaire de la région de Ain Ben Naoui (Biskra). Annales de l'I.N.A., Alger, 20(1 et 2), pp.1-8.
11. BENZAHI Y., 1994 -Contribution à l'étude de la dynamique des sels dans un sol irrigué sous palmeraie. Mémoire d'ingénieur d'Etat, I.N.F.S.A.S., Ouargla, 111p.
12. BHADRA A., RAGHUWANSHI N. S., SINGH R., 2012-Generation of monthly irrigation maps for India using spatial interpolation techniques. Sustainable irrigation and drainage IV. Wessex institute of technology, pp.291-302.
13. Bleu, P. (2008). Eau, énergie, dessalement et changement climatique en Méditerranée.
14. BOIS B., 2007- Cartographie agro-climatique à méso-échelle : méthodologie et application à la variabilité spatiale du climat en Gironde viticole. Conséquences pour le développement de la vigne et la maturation du raisin. Thèse de doctorat, Université Sciences et Technologies - Bordeaux I, 210p.
15. BONJEAN A., PICARD E., 1991. Les céréales à paille, origine histoire économie-sélection, Ligugé ; Poitiers : Aubin imprimeur, pp: 8-12.
16. BOUAMMAR B., 2010. Le développement agricole dans les régions sahariennes étude de cas de région de Ouargla et de la région de Biskra, Thèse de doctorat Université Kasdi Merbah Ouargla, 296 p.
17. BOUAMMAR B; 2015. La question de développement de la céréaliculture dans les régions sahariennes, 4éme Workshop sur l"agriculture saharienne, la céréaliculture dans les zones arides, Ouargla, 10 Mars, 12p.
18. Bouaroudj, S. 2012. Evaluation de la qualité des eaux d'irrigation, mémoire de magistère écologie, université de Constantine, p 75.
19. Bouchmel ,Mazzaferro, S., Bouchemal, K., Gallard, J. F., Iorga, B. I., Cheron, M.,Gueutin, C., ... & Ponchel, G (2011).Bivalent sequential binding of docetaxel to methyl-β-cyclodextrin. International journal of pharmaceutics, p 416(1).
20. BOULAL H., ZAGHOUANE O., EL MOURID M., REZGUI S., 2007. Guide pratique de la conduite des céréales d"automne (blés et orge)

dans le Maghreb (Algérie, Maroc, Tunisie), Ed, TIGC, INRA, ICARDA, Algérie, 176 p.

21. Brouwer, B., al Ashby, P. (1992) Corticospinal projections to lower limb motoneurons in man. Experimental brain research, 89 (3), p 649-654.
22. CAPILLON A., MANICHON H., 1991. Guide d‟étude de l‟exploitation agricole à l‟usage des agronomes, 2éme Ed, INA, Paris Grignon et APCA, 65p.
23. CCLS Ouargla, 2019.
24. RACHE A,. 1990. Etude comparative des taux d'infestation de deux variétés de dattes (Deglet-Nour et Ghars) par la pyrale des dattes Ectomyelois ceratoniae Zeller (Lepidoptera- Pyralidae) dans deux biotopes différents (palmeraies moderne et traditionnelle) dans la région de Ouargla. Mémoire Ingéniorat. ITAS. Ouargla : 85p.
25. Ramade F., 1984. Eléments d'écologie. Ecologie fondamentale. Ed. Mc Graw-Hill, Paris, 379 p
26. Ramade F., 2003 . Eléments d'écologie, écologie fondamentale, Ed, Dunod ,Paris ,P690. Station météorologique, 2019.Biskra
27. Sites wep http://madrp.gov.dz/agriculture/irrigation/agriculture-saharienn/2019
28. Stewart P., 1969 . Quotient pluviométrique et dégradation biosphérique. Bull. soc. hist. nat. agro. : 24 -25p.

Annexe 1

P5

N	CT%	CE mS/L	CA%	pH
Lp2 h20	37,55	3,3	10,5	6,59
Lp2 h8	36,73	3,65	15,5	7,96
Lp2 h25	35,91	6,27	14,5	6,17
Lp2 c5	45,71	3,22	16,5	6,78
LP2 V4	48,97	3,06	22	7,09
Lp2 h2	37	3,6	14	7,44
LP2 h26	41,25	3,34	13	7,27
LP2 c26	36,77	4,5	8	6,95
LP2 c7	50,61	4,14	13,5	7,07
LP2 H12	48,16	2,66	10,5	7,5
LP2 V5	49,75	5,15	27,5	7,16
LP2 C9	51,42	5,95	14	6,91
LP 2 V15	41,63	3,01	9,5	7,03
LP2 V17	43,22	6,25	14	6,46
LP2 H9	48,97	5,7	15,5	6,4
LP2 C25	40,81	2,9	26	6,91
LP2 H19 02	43,22	5,8	15,5	6,66
Lp2 v7	38,06	3,07	21,5	7,21
LP2 C2	51,30	2,75	27	7,91
Lp2 H21	42,22	2,2	12,5	6,74
Lp2 c10	40,6	3,18	23,5	7,11
LP2 c1	47,34	4,5	7	7,01
LP2 C 32	34,19	6,3	8	6,2
LP 2 H10	39,35	4,1	15	7,08
LP2 C48	37,4	5,7	10	6,55
LP2 V14	36,77	3,65	14,5	6,78
LP2 C8	40,06	5,3	16	6,88
LP2 C47	38,7	3,8	7,5	6,7
Lp2 c31	33	3,77	16,4	7,1
LP2 C6	50,53	3,06	22	7,91
LP2 C1	39,38	2,4	28	7,15
Loutaya P2V1	48,69	1,95	18,5	8,15
LP2 H11	35,69	5,69	14,6	6,89
LP2 C38	38,65	3,05	20,5	7,27
LP2 V2v17	41,65	3,43	20,5	7,9
Lp2 v18	43,05	3,5	19,5	7,03
lp2 c3	38,76	3	12,5	7,21
Lp2 h21	42,5	3,01	13,5	6,75
Lp2 c40	38,53	5,42	26	6,99
Loutaya P2C6	45,21	2,66	20	7,72
Lp2 c28	40,92	2,34	14	7,74
Lp2 h22	43,45	3,4	10	6,64
LP2 v7**	45,53	3,2	14,3	7
LP2 c34	46,72	3,32	15	6,86
LP2 h12	43,71	1,91	11,8	7,83

lph24	39,35	7,3	7,5	6,3
LP C 4*	32,5	2,17	14,3	7,13

table represents the results of the analyzes that used in the map pivot 6

P5				
LP1 v19	42,75	2,1	14,5	7,35
p1c32	46,2	5,25	8,5	6,63
	51,72	4,91	11	7,04
LP1 H20	47,58	3,7	16	7,19
LP1 c*1*1	49,79	3,51	17	7,15
LP1 c3	44,82	3,7	12,5	6,55
LP1 c33	41,1	3,9	7	6,78
LP1 c41	51,03	4,01	16,5	6,32
LP1 C26	46,89	4,02	12,5	6,1
Lp1 h23	46,89	3,4	13,5	7,89
LP1 c27	48,27	5	14,5	6,08
LP1 c4	46,2	2,8	15	6,91
LP1 v3	47,58	3,9	15,5	6,98
LP1 h9	44,82	5,3	9	6,68
LP1 C*	50,34	4,2	10	6,41
LP1 C29	45,53	4,7	19,5	7
LP1 c49	44,82	3,89	12	6,88
LP1 c39	38,62	3,04	15	7,2
LP1 c37	45,51	3,9	10,5	6,86
LP v18	53,79	3,63	17,5	7,14
LP1 c4	48,96	2,8	13	6,91
Lp1 c50	36	3,72	13	6,73
LP1 v15	34	3,02	18,5	7,14
Loutaya P1V16	73,04	5,01	17	8,15
LP1 c30	37	4,92	10	7,04
LP1 c36	37,5	5,21	13,5	7,89
LP1 v7	33	2,99	19	7,08
Lp1 28h	40,61	4,02	14,9	7,02
LP1 c43	41	2,63	10,5	5,23
LP1 v6	36,5	3,3	17,5	6,99
LP1 h13	35,5	1,84	17	7,21
LP1 h6	33,5	5,6	18,5	6,19
LP1 c42	44,46	2,6	22,5	6,74
LP1 h8	35	5,01	14	6,64
LP1 c2	35	2,93	15	7,74
LP1 c46	33	3,93	12	7,05
LP1 h10	38,5	4,4	13,5	7,21
LP1 v7	48,5	4,7	9	7,07

LP1 v2	39,5	4,14	11	7,07
Loutaya P1 45	40,86	5	24,5	7,08
Loutaya P1 ch	47,82	4,2	23,5	7,71
LP1 H11	42,46	2,93	17,5	7,42
p1c (3)	50,34	4,2	10	7,35
lp1c (4)	48,96	3,22	17,5	7,47
LP1 C..	50,34	4,7	12,5	7,25
Lp1 V5 *	35,48	4,5	28,5	7,02

table represents the results of the analyzes that used in the map pivot 5

Tableau 1 Irrigation standards (Ayers and Westcot, 1994)

Physicochemical parameters	**Standards (maximum allowable value set by Ayers Westcot 1994)**
CE conductivity	<3 mS/cm
PH	-
Calcium (Ca+2)	20 meq/l
Magnesium (Mg)+2)	5 meq/l
Potassium (K+)	2 meq/l
Chlorure (Cl-)	20 meq/l
Bicarbonate (HCO3-)	50meg/l
Sulphate (SO42-)	20 meq/l
Sodium (Na+)	40meq/l

Tableau 2 Interpretation scale of total limestone (CaCO3)

CaCO3(%)	**Soil**
CaCO3(%)<1%	Non-calcareous
1<CaCO3(%)<5%	Not very calcareous
5<CaCO3(%)<25%	Moderately calcareous
25<CaCO3(%)<50%	Highly calcareous
50<CaCO3(%)<80%	Very strongly calcareous
80<CaCO3(%)	Excessively calcareous

Tableau 3 Interpretation scales for organic matter (ITA, 1977

MO%	**Soil**
MO<1	Very poor
1<MO<2	Poor
2<MO<4	Medium
4<MO	Rich

Tableau 4 pH interpretation scales of the (Sarkar and Haldar, 2005)

pH	Interpretation
<4,5	Extremely acidic
4,5-5,0	Strongly acidic
5,1-5,5	Very acidic
5,6-6	Moderately acidic
6,1,6,5	Weakly acidic
6,6-7,3	Neutral
7,0-8	Moderately basic
8,1-9	Very basic

Tableau 5 Scale of salinity according to the EC of the diluted extract 1/5 (Aubert, 1978)

EC Ds/m at 25°C	**Dergrees of salinity**
CE<0,6	**Non salty soils**
0,6<EC<1,2	**Low salinity soils**
1,2<EC<2,4	**Salty soils**
2,4<EC<6	**Very salty soils**
6<EC	**Extremely salty soils**