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Project Acronym: ISFERALDA

Project title: Improving Soil FERtility in Arid and semi-arid regions using Local organic DAte palm residues

D3-1 Site selection

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Summary

The deliverable D3-1 presents the different study sites of the ISFERALDA project. It describes climatic, geologic and edaphic context of each site.

Study sites are Two study sites are located in Tunisia: El Fje Medenine and Kebili sites. Three study sites are located in Algeria: Oued Righ, Biskra and Ouargla sites. Two study sites are located in Spain: Canada de Gallego and Saladares del Guadalentin.

Three of the seven sites are located in oasis ecosystems. The other four sites are located in different contexts but are related to some of the problems encountered in oases: soil salinity problems for one site and different soil types for the other.

All these study sites provide are representative of the different contexts encountered in the arid environments of North Africa.

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1 Tunisian sites

1.1 El Fje Medenine site

1.1.1 General description

The governorate of Medenine is located in southeastern of Tunisia, and is structured in 9 delegations. It is bounded by the governorate of Gabès and the Mediteranean Sea at the north, by the governorate of Tataouine at the south, the governorate of Kebili at the west and the Lybian state at the east (Table 1). It covers 5 500 ha for 71 406 inhabitants. Experimental fields are not located in an oasis ecosystem.

Table 1 Coordinates of Governorate of Medenine and the Arid Regions Institutes

Sites	Coordinate
Arid regions Institute	33.53095386 North 10.68514827 East
Governorate of Medenine	33.34059511 North 10.49348760 East

Figure 1: Experimental fields of El Fjé Médenine site (Source : Mohamed MOUSSA)

1.1.2 Climatic presentation

The climate is influenced by the Sahara in the west and Boughrara gulf in the eastern north. The climate is considered as arid and Saharan arid. Rainfall is scarce during the year; and the temperature is very high (Figure 2, Figure 3).

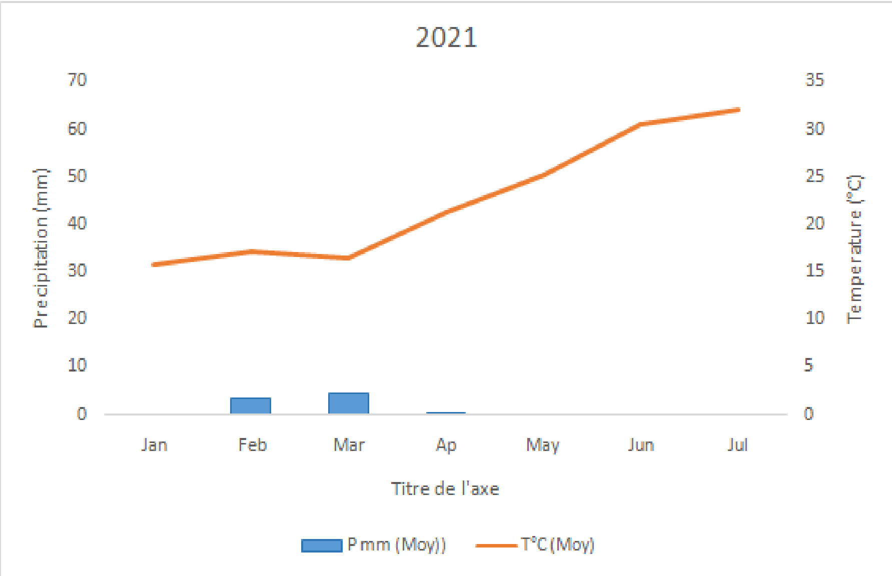

Figure 2: Climatograph of El Fjé (Medenine) during 2021 year

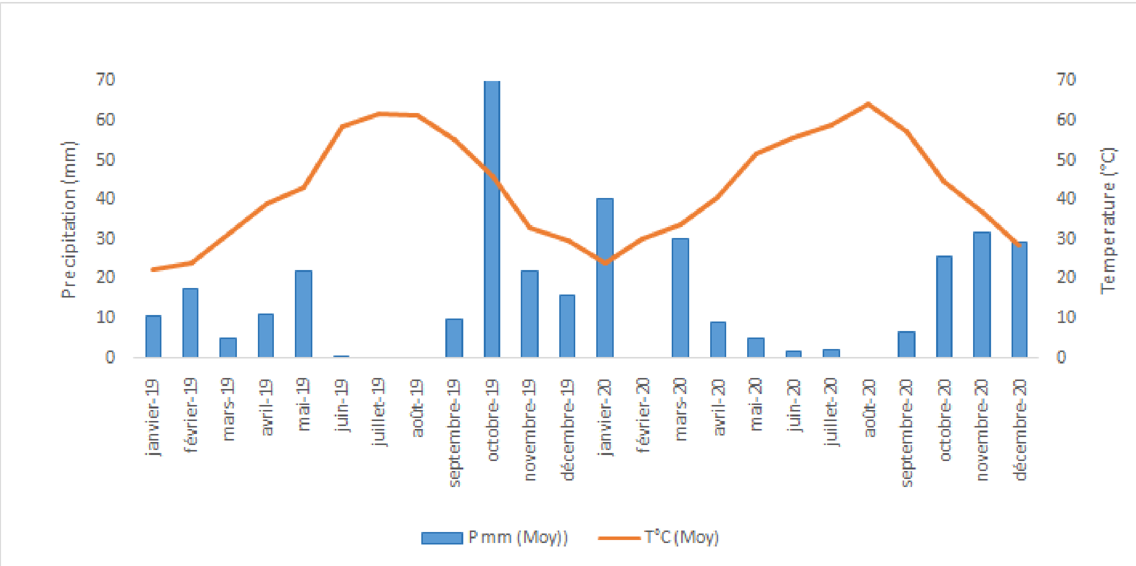

Figure 3: Climatograph of El Fjé (Medenine) during 2019/2020

1.1.3 Geological context

The region is delimited, from east to west, by the plain of Djeffara, the chain of the mountains of Matmatas and Dahar. It is characterized by the dominance of layers of secondary, tertiary and quaternary ages which outcrop on the surface (Afrasinei *et al.*, 2018). All these formations are dominated by a limestone, marl-limestone and gypsum facies. The presence of limestone and gypsum strongly influences the soils of the region.

1.1.4 Edaphic presentation

Soil salinity in Medenine is increasing due to intense evaporation and the use of medium and high salinity water for irrigation. Climatic factors and the alteration of geologic formation rich on sodium (Na^{+}), magnesium (Mg^{2+}), calcium (Ca^{2+}) are also the causes of soil salinity in arid regions. In this context and without other alternatives, soils are getting more and more salty, and the vegetation cover, especially glycophytes, decreased. In fact, this degradation leads to a decrease in plant production caused by the decrease of soil fertility (Sbei *et al.,* 2012). As a result, the economic and ecological values of these soils are decreasing. That is why the soil in Medenine needs to be restored in order to improve soil fertility using sustainable farming.

Soil salinity is a major problem facing the drylands of North Africa. This is one reason why this site was selected for the ISFERALDA project.

1.2 Kebili site

1.2.1 General description

Kebili is a Tunisian governorate in south-western Tunisia. The study was carried out at the continental oasis of Guettaaya (Ettillaat) at Kebili which is in the southern of Tunisia. This oasis is located between 8.27° to 8.29° N latitude and 33.24° to 33.26° E longitude (Ibrahim *et al*., 2019). The oasis is adjacent and to the west to Chott El Djerid, a salt plain.

Figure 4: Satellite maps of the two tunisian sites: red square is Kebili oasis and the blue square is Medenine (IRA) site. (Source: google map; Imagery 2021, Terrametrics, Map Data 2021)

1.2.2 Climatic context

Guettaaya oasis, also called Etillat oasis, is characterized by a desert climate, annual precipitation is irregular and less than 90 mm, and the temperature is very high during the summer (maximum 55 °C in July). Evaporation can reach 2000 mm per year. In spring and summer, the strong and hot sirocco winds blow carrying the desert sands to the oasis (Sghaier, 2010).

1.2.3 Geological context

The site is located on a flat plain made up of Holocene lacustrine sediments, which developed mainly as alluvium and evaporites. To the north, the area is bounded by the Saharan Atlas Mountains, while to the south are dunes that are part of the Grand Erg Oriental. The depression of this site is mainly filled with erosional material from the north and aeolian material transported by southern winds, as well as evaporite deposits. A characteristic feature of the area is the presence of gypsum crusts on the soil surface (Machowski *et al*., 2017).

1.2.4 Edaphic context

The soils of the Etillat oasis are classified as Gypsisols according to the WRB classification. The sandy soils of the oasis are characterized by high permeability and low water retention (Kadri and Van Ranst, 2002). Groundwater and soil salinity vary with the depth of the water table. The study area is irrigated by a surface irrigation system. The plots of date palm plantations are connected to drainage collectors installed in the saline depression of Chott El Djerid.

The vegetation cover of Etillat oasis is mainly composed of date palm (Phoenix dactyliferaL.) of Deglet Nour variety, and alfalfa (Medicagosativa) fodder for its high tolerance to salt (Mezni et al., 2002).

This site in an oasis ecosystem is representative of many palm groves in southern Tunisia.

2 Algerian Sites

2.1 Oued Righ Site

2.1.1 General description

The region of Oued Righ is located in the north of the Algerian Sahara. In this region, there is a vast set of palm groves surrounded by dunes. This region is bordered by the Ziban region to the north, to the east by the large dune alignments of the eastern erg, to the south by the oases of Ouargla and finally to the west by the Dzioua depression (Figure 5).

This region is known for the considerable development of its oases, which produce dates of excellent quality. These oases are distributed from north to south, from the important oasis of Ourirup to that of Témacine, over a length of about 150 km. The width of the area varies between 20 and 30 km. (Figure 6).

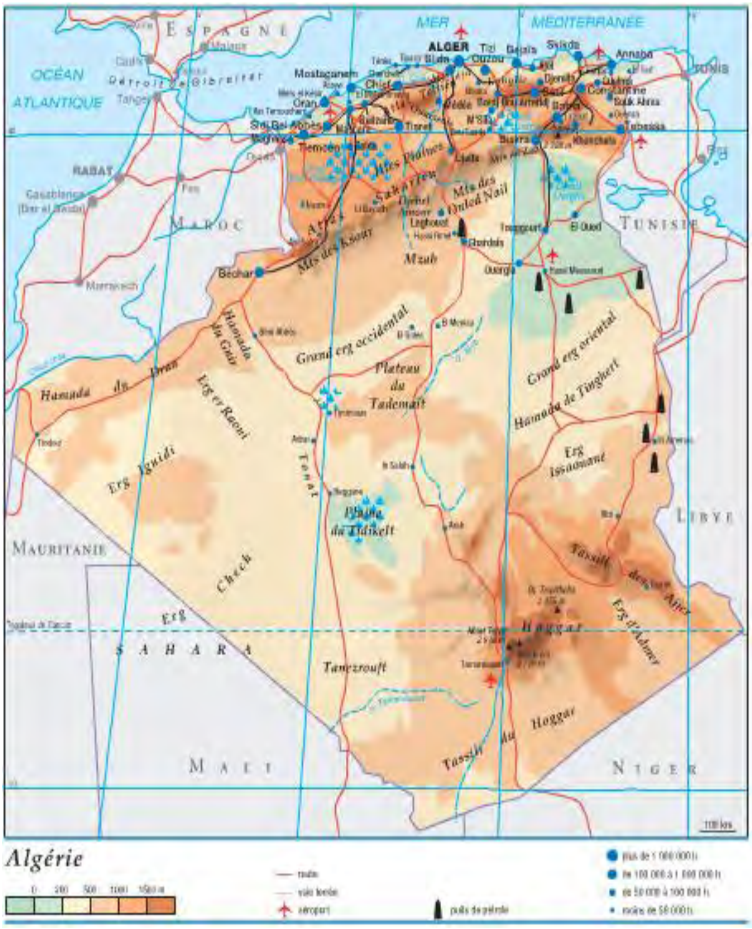

Figure 5: Geographical map of Algeria

Figure 6: Geographical map of Oued Righ site

2.1.2 Climate context

The climate of Oued Righ is a hot desert climate as Saharan type, characterized by very scarce and irregular precipitation, by high temperatures with large daily and annual amplitudes and low relative air humidity (Table 2).

In fact, rainfall is very rare; the annual average is slightly above 50 mm for a number of rainy days of 25 days. These rains are stormy types characterized by high intensity, thus generating important floods that only persist for a few minutes (O.N.M, 2003). Winds are frequent in Oued Righ region. In winter, the westerly winds dominate. In spring, northeast winds dominate, while in summer southwest winds are dominant (O.N.M, 2013). In the region of Oued Righ, the maximum evapotranspiration has a significant seasonal variation. The monthly Potential evapotranspiration (PET) in winter is three times less than the monthly PET in summer (Table 2).

Table 2: Climatic data (1983-2003 period)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*
Min temperature (°C)	4.92	4.9	9.36	12.1	17.4	23.5	26.0	26.6	21.8	18.	9.92	6.07
Max temperature(°C)	17.22	20.5	23.41	28.6	32.7	37.3	40.0	40.2	32.8	25.1	22.8	18.6
Rainfall (mm)	17.2	8.1	12.4	6.3	5.8	1.2	00	00	5.18	6.2	5.2	5.42
Relative air humidity(%)	57.32	53.5	48.92	45.0	40.0	36.9	32.4	35.5	42.8	53.1	62.43	65.28
Wind speed (m/s)	2.8	3.1	3.52	5.27	4.02	3.84	3.04	3.01	2.67	2.4	2.56	2.48
Sunshine duration (hour)	6.12	7.5	7.41	8.9	9.14	9.62	10.7	9.58	8.34	7.5	6.66	6.20
PET (mm/day)	2.23	3.4	4.14	6.41	7.85	9.25	10.1	9.92	6.32	4.6	3.13	1.86

Source: Mean climatic data of agrometeorological station of the I.N.R.A.A of Touggourt

2.1.3 Geological Context

The parent material of the soils of Oued Righ is of mixed allu-colluvial and aeolian origin. Alluvium and colluvium come from the erosion of the encrusted level dating from the ancient Quaternary or the Mio-Pliocene. The successive phases of erosion and filling of the valley floor are responsible for the textural heterogeneity observed in the deep horizons, particularly along the chott route (SOGETA-SOGHREA, 1969-1970).

If it is accepted that the drying of the northern Sahara began after the Wurm Glaciation, the emplacement of the soil materials dates from the Soltanian, but the upper horizons are largely of eolian origin (SOGETA-SOGHREA, 1969-1970).

2.1.4 Edaphic context

The pedogenesis of the soils of the site is dominated by the action of groundwater and the salts it contains. Under equal conditions, the degree of development of the morphological characteristics of the soils depends on the clay content (SOGETA-SOGHREA, 1969-1970).

The soils contain a very high proportion of gypsum crystals of all sizes (40% on average). The superficial and shallow horizons (less than 70 cm) are homogeneous. Their clay content varies from 5 to 10% and their texture is a loamy sand or a sandy loam (SOGETA-SOGHREA, 1969-1970). Also, most soils are salty or very salty, but there is no alkalinization of the absorbing complex. In fact, the type of salt is calcium sulfate up to 6 mmhos / cm, sodium chloride beyond. The ions present are chlorides and sulfates. The contents of bicarbonate are always low. The contents of carbonates are null. The cations are represented by sodium. Calcium is found in the form of gypsum and is therefore not very soluble. The potassium content is always low. The pH is slightly alkaline and varies between 7.5 and 8.5. The organic matter content is very low and comes mainly from the manure applied in the palm grove.

In addition, the physical properties of the soils are characterized by a low apparent density of the soils in the regularly plowed surface horizons. It is about 1.25 with 75% of the results between 1.05 and 1.35. In the underlying horizons, it is slightly higher: it is about 1.30 with 75% of the results between 1.15 and 1.45. The total porosity of the surface horizons has values between 40 and 60%. In the deeper horizons, the porosity is lower than that of the surface horizons, with values between 30 and 45%.

As Kebili site, Oued Righ site is an oasis ecosystem representative of many palm groves of the region.

2.2 Ouargla site

2.2.1 General description

The Hassi Ben Abdallah farm in the Ouargla basin is one of the ITDAS demonstration and seed production farms (Figure 7).

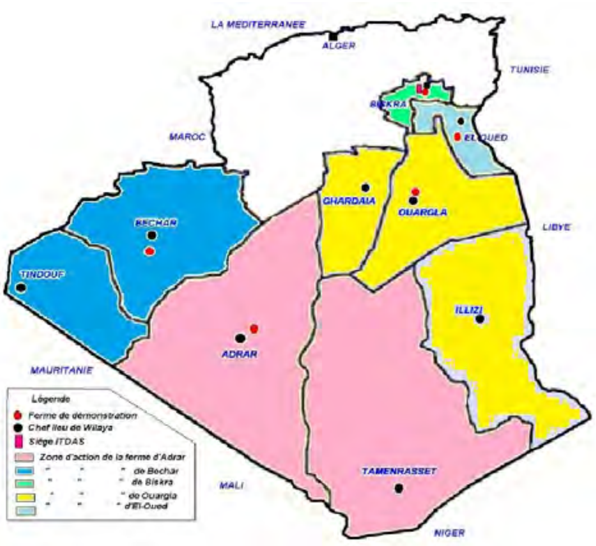

Figure 7: Location of Ouargla site in Algeria

The farm is located in 30 km east of the city of OUARGLA, in an oasis, in the south-eastern sector of the Hassi ben Abdallah palm grove. It is located at an altitude of 156 meters at 32°0'24.46" N latitude, longitude 5°28'48.66" E. It covers an area of 21 ha. It was created from drillings in the albian groundwater.

Ouargla site is the third study site with an oasis ecosystem representative of many palm groves of the region.

2.2.2 Climatic context

Warm Siroco winds and sandstorms cause a greenhouse effect throught the dust they raise. These contribute to the drying out of the climate, requiring the use of irrigation. The dominant climate in Ouargla is Saharan. During the year, there is practically no rainfall. The average temperature in Ouargla is 22.9°C. The average annual rainfall is 39mm.

With an average of 10mm of rain, January is the month with the highest rainfall. June, July and August are the driest months with average rainfall close to 0mm.

Monthly average temperatures between 1999 to 2019 are above 20 °C from April to October. The highest monthly average temperature is recorded in July (35.2 °C) and the lowest in January (10.5 °C).

The average maximum temperature varies from 16.3 °C in January to 41.7 °C in July; the average minimum temperature varies from 5.1 °C in January to 27.4 °C in July.

The average monthly atmospheric humidity between 1999 and 2019 in Ouargla is characterized by low values, around 32.9%. The maximum humidity is recorded during the month of December with 57% and the lowest in July with 17%.

Table 3 : Climatic data for Ouargla (1999 to 2019)

	January	February	March	April	May	June	July	August	September	October	November	December
Average temperature (°C)	10,5	12,8	17,7	22,5	27,4	32,1	35,2	34,3	30,1	24,1	16,1	11,4
Average minimum temperature (°C)	5,1	6,7	10,9	15,3	20	24,3	27,4	26,9	23,4	17,7	10,5	6,2
Maximum temperature (°C)	16,3	18,8	23,9	28,8	33,6	38,5	41,7	40,6	36	29,8	21,6	16,8
Precipitation (mm)	10	3	5	4	2	0	0	0	3	4	4	4
Humidity (%)	54%	40%	31%	25%	22%	19%	17%	20%	28%	35%	47%	57%
Rainy day (day)	1	1	1	1	0	0	0	0	1	1	1	1
Hours of sunshine (h)	8,8	9,8	10,6	11,5	12,4	12,8	12,6	12	11,1	10,2	9,3	8,7

Source : https://fr.climate-data.org/afrique/algerie/ouargla/ouargla-3694/#climate-graph

2.2.3 Edaphic context

The soil at this study site is a predominantly sandy, highly alkaline and has low salinity. This soil is moderately calcareous and slightly gypseous according to the classification of Baize, 2000.

Table 4 : Characteristic of the soil of the Ouargla plot

Depth cm	Physical characteristics			Physico-chemical characteristics		Chemical characteristics	
	Particle size			pH (1/2.5)	Electrical conductivity (CE 1/5) (dS/m)	Limestone (%)	Gypsum (%)
	Sand	Silt	Clay				
0-20	82.5%	10.7%	4.6%	8.5	0.95	11%	1.658
20-40	90%	5.9%	4.1%	8.64	0.79	17%	1.658

2.3 Biskra site

2.3.1 General description

The wilaya of Biskra is located in the south-east of Algeria, in the southern piedmont of the Saharan Atlas. It covers 21,671.20 km2. It is located at an altitude of 87 meters, its latitude is 34° 48' North and its longitude is 5° 44 'East. This site is not located in an oasis ecosystem.

2.3.2 Climatic context

Monthly average temperatures during the period 2002 to 2011 are above 20 °C from April to October. The highest monthly average temperature is recorded in July (35.1 °C) and the lowest in January (11.6 °C).

The average maximum temperature varies from 17.3 °C in January to 41.3 °C in July; the average minimum temperature varies from 6.7 °C in January to 28.1 °C in July.

The Biskra region is characterized by generally low and irregular rainfall. The annual average rainfall is around 146.2 mm during the period 2002 – 2011. The maximum rainfall is recorded in March (23.5 mm). The minimum is recorded between June to August.

The average monthly atmospheric humidity between 2002 and 2011 in Biskra is characterized by low values, around 41.5%. The maximum humidity is recorded during the month of December with 59.6% and the lowest in August with 28.6%.

The annual average speed of the prevailing winds is 15 $m.h^{-1}$. In the region of Biskra, the prevailing winds in winter come from north-west, they are relatively humid. From spring, the prevailing winds come from the south-east, they are very dry, hot and accompanied by sand. According to the Gaussen

Ombrothermal diagram applied to the Biskra region, the dry period is present during the whole year (Figure 8).

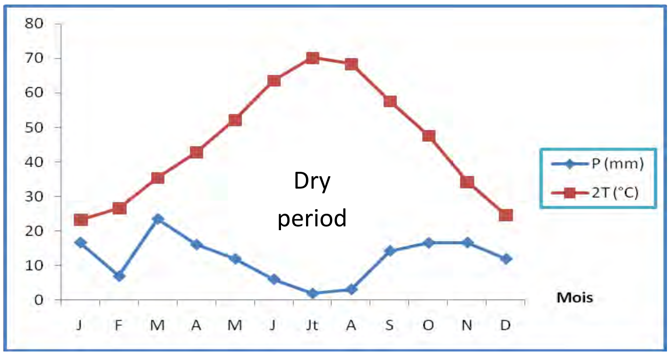

Figure 8: Gaussen ombrothermal diagram of the Biskra region for the period 2002 - 2011

The rainfall quotient of Emberger "Q" specific to the Mediterranean climate allow the location of the bioclimatic stage of the study area. This quotient takes into account annual rainfall and minimum average temperatures of the coldest month and maximum average temperatures of the hottest month.

$$Q = 3{,}43 \times \frac{P}{M - m}$$

Where R is the average monthly rainfall (mm)
M is the maximum average temperature (degree Celsius)
m is the minimum average temperature of the coldest month (degree Celsius)

For the region of Biskra, during the period 2002 to 2010, the rainfall quotient (Q) is 14.41. By carrying this value on the climagram of Emberger and the temperature of the coldest month, the region of Biskra is located in the Saharan bioclimatic stage with moderate winter (Figure 9).

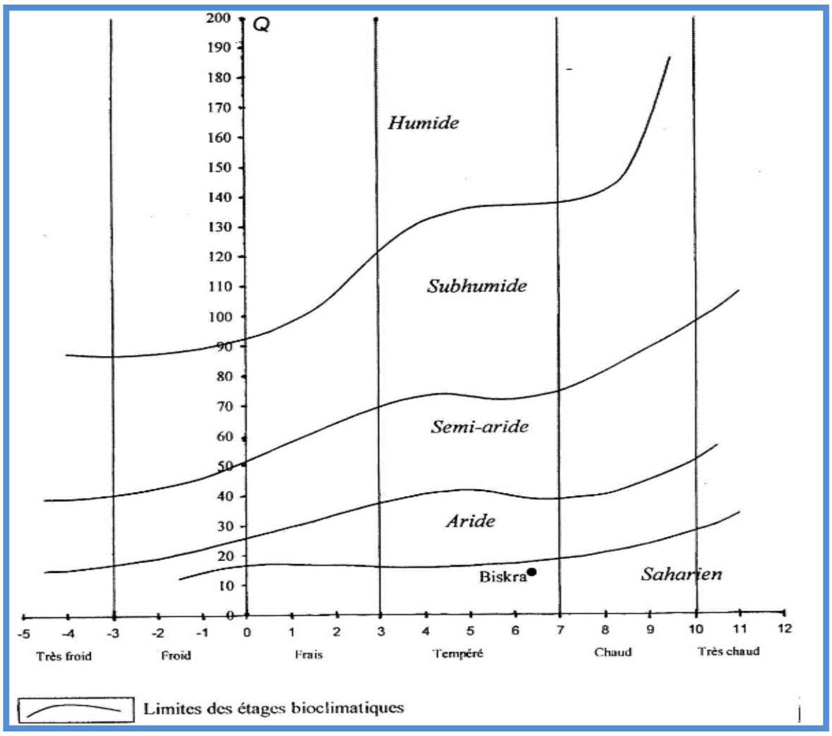

Figure 9: Location of the Biskra region on the Embergerclimagramme

2.3.3 Geological context

The geological formations are mainly calcareous sedimentary formations. The rocky outcrops, which constitute the main reliefs of the Wilaya, in this case the mountains, located at the northern limit, are sediments dating for the most part from the secondary era. The large plains in the centre are made up of sediments from the quaternary era, while the plateaus are largely composed of formations from the tertiary era.

From a lithological point of view, the main formations in the wilaya are sandy-clay alluvium, limestone, dolomite, marl, clay, sand, sandstone and sedimentary salts of chott or diapiric salt.

From a tectonic point of view, the north of the region is affected by the great tectonic accident, known as the "South-Atlas flexure", which is a kind of break separating the northern part of the country (the Tell) from the collapsed zone of the desert (the Sahara). This fault is characterised by the presence of multiple faults (brittle tectonics) and a soft, folded structure (soft tectonics) (ANAT, 2003).

2.3.4 Edaphic context

For ISFERALDA project, experimental site of the agronomic sciences department of the University Mohamed Khider of Biskra (UMKB) has been chosen.

Characteristics of the soil sampled in the layer 0-30 cm are presented in the table 5.

Table 5 : Physico-chemical properties of the soil of the experimental site

Parameters	
Organic matter (%)	1,67
Active limestone (%)	24,5
Total limestone (%)	42,83
Assimilable phosphorus(ppm)	142,5
Electrical conductivity(dS/m)	2,91
pH	7,66
Granulometry	
Coarse sand (%)	6,79
Fine sand (%)	4,68
Coarse silt(%)	8,18
Fine silt (%)	44,20
Clay (%)	36,15

The Biskra site has a different soil type compared to the other sites studied. The study of this soil type is important because it is representative of the region and has different agronomic qualities.

3 Spanish sites

3.1 Cañada de Gallego site

3.1.1 General description

The Cañada de Gallego site is located in the south west of the region of Murcia (Figure 10). In this region, there is a vast set of greenhouse cultivation. This region is located 11 kilometers from Mazarrón between the coast and the Sierra de las Moreras.

From 1970 onwards the population increased considerably thanks to irrigation and the construction of greenhouses. Currently, there are several agricultural export companies in the city.

Figure 10 : Satellite map of the Cañada de Gallego site

3.1.2 Climatic context

A steppe climate is present in this region. According to the Köppen-Geiger classification, the climate of this region is semi-arid (BSh).

The average monthly rainfall is between 2 and 38 mm (Table 6). The summer months (Jun-Aug) are the driest. It is in the fall (Sept-Nov) that rainfall is the most important. The average annual rainfall is 272 mm.

As expected, the coolest temperatures are measured in winter from December to March with values below 15°C. From June to October, the average monthly temperature is above 20°C. In July and August, it even exceeds 25°C.

Atmospheric humidity reaches values of over 70% during the warmer periods (July-Oct) and decreases to 66% when temperatures decrease (Nov-Apr).

Table 6 : Climatic data for Arguilas, 10 km south-west of Cañada de Gallego site (1991 to 2021)

	January	February	March	April	May	June	July	August	September	October	November	December
Average temperature (°C)	12,2	12,5	14	16	18,8	22,6	25,1	25,8	23,5	20,3	15,7	13
Average minimum temperature (°C)	9,6	9,8	11,1	13,1	15,9	19,6	22,2	23,2	21	17,9	13,2	10,6
Maximum temperature (°C)	14,9	15,3	16,9	18,7	21,6	25,4	27,9	28,5	26,1	22,7	18,1	15,6
Precipitation (mm)	27	22	29	26	20	6	2	7	38	36	33	26
Humidity (%)	69%	66%	68%	68%	69%	69%	72%	72%	71%	74%	68%	70%
Rainy day (day)	3	3	3	3	2	1	0	1	3	4	4	3
Hours of sunshine (h)	7,6	8,2	9,5	10,7	12	12,8	12,3	11,1	9,7	8,7	8	7,3

Source : https://fr.climate-data.org/europe/espagne/region-de-murcie/aguilas-27540/

3.1.3 Geological context

The site is located on Messinians lacustrine sediments, which developed mainly as alluvium and evaporites. This geological unit is mainly composed of calcarenite and algal and brecciated limestone. To the east, the area is bounded by the Calnegre Mountains.

3.1.4 Edaphic context

Characteristics of the soil sampled in the layer 0-30 cm are presented in the table 7.

In relation to the crops, the greenhouse where we sampled soil is cultivated during wintertime with horticultural crops. No mineral fertilizers are applied. Manure is applied every year (about 150 kg

N/ha). In the year 2021 there was a ginger crop, from March to December, which was irrigated with about 800 mm of water. This crop extracted about 115 kg N/ha.

Table 7 : Physico-chemical properties of the soil of the Cañada de Gallego site

Parameters	
Organic matter (%)	2,17
Organic carbon (%)	1,26
Total nitrogen (%)	0,19
C/N	6,8
Active limestone (%)	2,9
Total limestone (%)	11,6
Assimilable phosphorus(ppm)	254
CEC (meq/100g)	6,1
pH	7,92
Granulometry	
Sand (50-2000µm)	42,76
Silt (2-50µm)	55,06
Clay (<2µm)	2,18

3.2 Saladares del Guadalentin site

3.2.1 General description

The Saladares del Guadalentin is an alluvial plain with a saline character located in the south of the Murcia region (Figure 11). This salar has a zone characterized as a crypto-wetland and a steppe zone with saline steppes. It is in the steppe zone that we took our samples.

This area is a protected zone due to the presence of Halocnemum strobilaceum, a critically endangered species.

Figure 11 : Satellite map of the Saladares del Guadalentin

3.2.2 Climatic context

A steppe climate is present in this region. According to the Köppen-Geiger classification, the climate of this region is semi-arid (BSk). This region has more or less the same seasonality as the Cañada de Gallego site as they are located within 50 km of each other.

The average monthly rainfall is between 4 and 48 mm (Table 8). The summer months (Jun-Aug) are the driest. As for the other Spanish site, it is in the fall (Sept-Nov) that rainfall is the most important.

The coolest temperatures are measured in winter from November to March with values below 15°C. From June to September, the average monthly temperature is above 21°C. In July and August, it even exceeds 25°C.

The average maximum and minimum temperatures follow the same trend as the average temperatures. From November to March, average maximum temperatures are below 18°C and average minimum temperatures are below 8°C. As temperatures rise from June to September, average maximum temperatures exceed 28°C (in July and August, it even exceeds 30°C) and average minimum temperatures are above 15°C.

The average monthly atmospheric humidity between 1991 and 2021 in Saladares del Guadalentin is around 61%. The maximum humidity is recorded during the month of December with 72% and the lowest in June with 49%.

Atmospheric humidity reaches values of over 65% during the cold period (Oct-Jan) and it drops below 60% when temperatures rise (Apr-Aug). The humidity even drops to 49% in June.

Table 8 : Climatic data for Totana (1991 to 2021), 5 km west of Saladares del Guadalentin site

	January	February	March	April	May	June	July	August	September	October	November	December
Average temperature (°C)	7,8	8,9	11,5	14,3	18	22,7	25,3	25,2	21,4	17,3	11,5	8,5
Average minimum temperature (°C)	5,1	6,7	5,5	8,2	11,5	15,9	18,8	19,2	16,1	12,4	6,7	3,7
Maximum temperature (°C)	13,8	14,9	17,7	20,2	23,8	28,9	31,6	31,3	26,9	22,7	16,9	14,2
Precipitation (mm)	30	29	37	36	31	14	4	13	48	40	36	31
Humidity (%)	69%	63%	61%	57%	54%	49%	52%	56%	63%	69%	68%	72%
Rainy day (day)	4	3	4	5	4	2	1	2	4	5	4	4
Hours of sunshine (h)	7,5	8	9,2	10,5	11,8	12,8	12,4	11	9,4	8,4	7,7	7,1

Source : https://fr.climate-data.org/europe/espagne/region-de-murcie/totana-30721/

3.2.3 Geological context

The major part of the study area is covered by surface formations of the Quaternary. These formations cover other older geological formations. Depending on their age and nature, it is possible to distinguish different types of deposits.

Colluvial sediments are the oldest surface formation, they appeared at the base of mountainous reliefs. These can occupy large areas, as is the case in the eastern foothills of the Sierra Espuña. They formed almost flat surfaces, with a slight slope towards the east, formed by detrital sediments with calcareous crusts. These are formed by the leaching and subsequent deposition of calcium bicarbonate from neighboring landforms. They formed large glacis generally dug by recent erosive phenomena.

On the northern slopes of the Sierra de Carrascoy there are important alluvial cones formed by heterometric edges of slate, quartzite, phyllite, marble, etc. These are cemented by a reddish silty matrix with calcareous crusts. These are cemented by a reddish silty matrix with calcareous crusts. The coalescence of these cones has also given rise to conglomeratic glacis, which have been severely cut by the erosion of the numerous steep torrential riverbeds that descend from the sierra.

At present, a large part of the limestone crusts of the glacis are fragmented due to the ploughing of the agricultural land.

There are also Quaternary deposits covering extensive depressions. These are detrital sediments resulting from the physical and chemical alteration of different types of rocks and the erosion of soils located upstream.

3.2.4 Edaphic context

According to the FAO soil classification (2014), the soil at our study site would be a Fluvi-Gypsic Solonchak and, according to our textural analyses, this soil has a silty loam texture.

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