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# Varietal Diversity of Date Palm (*Phoenix dactylifera* L.) in South-western Oases of Algerian Sahara: A Review

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## ABSTRACT

We designate here the name designate 'oasis' (Wit in Egyptian, Wah in Copte, Waha in Arabic et in Persian, Neve in Hebrew, et Ouasis in Greek), points located in the desert and which are distinguished from the surrounding environment by more or less abundant vegetation. The date palm (*Phoenix dactylifera* L.) is the backbone of the oasis and it is the one that must be protected. This review has the objective toexplain the typological and agroecosystem of saoura oasis and its contraints. The data obtained in this study are based on statistics from national and international institute like CRSTRA, ONID, ITDAS and RADDO and also from surveys and prospecting missions with the help of farmers who have given us all the routes carried out in their fields and the main constraints that affect this kind of crop. The data obtained showed that the oasis has certain pedoclimatic, geological and hydrogeological properties specific to the arid environment. The oasis agrosystem studied (saoura) has certain specificities compared to others, such as the absence or presence of certain constraints on the date palm such as the bayoud and the date moth. Regarding varietal diversity, 'Feggous and H-mira', these are the most important varieties in Saoura region, but are sensitive to certain constraints such as Bayoud, which requires the selection of new resistant varieties.

**Key words:** Date palm, Oasis, *Phoenix dactylifera* L., Saoura, Varietal diversity.

The Algerian Sahara represents nearly 85% of check it of the country. The population of the great south represents 10.60% of the total population. It is in this vast Saharan territory that human genius has set up a system of exploitation of the environment in order to meet their daily needs, for the establishment and stability of populations (Moulai and Yahaya, 2020). This gave birth to places of life "the Oases" in an environment naturally hostile to human settlements. This is an age-old system based on the rational management of water and land resources with associated high-performance biological material "the date palm"(Moulai and Yahaya, 2020).

The oasis (literally "inhabited place") is an intensively cultivated space in a desert environment. These domesticated ecosystems, based on a multitude of water demobilization methods, share a certain number of completely original characteristics: polyculture-livestock systems, layering of vegetation whose dominant layer are often made up of date palms, very intensive cropping systems and a collective organization of space (Toutain, 1987; Battesti, 2005).

Long considered in decline, the Sahara oases experienced an astonishing "revival" in the second half of the 20th century: "Saharan agriculture ... conquered new lands, renewed its methods and presents itself as a vast front. Pioneer, multi-form and multi-location"(Cote, 2002). Depending on the location, it is an agriculture of contractors (the Libyan case with its cereal pivots is quite emblematic) or on the contrary an agriculture based on solid peasantry, while mobilizing groundwater through deep boreholes, for example in the Ziban in Algeria or the Nefzaoua in Tunisia (Cote, 2002).

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The province of Saoura region has an area of 161,400 Km$^2$ located in the South West of Algeria (Fig 1), at a point of widening of this long and narrow valley by the Western Erg to the East and the Ougartamountain chain to the West, it represents the most important oasis in the valleys of Saoura, Guir, Zouzfana and Bechar (Fig 2). The Saoura region is a part of the great Algerian Sahara (Cote, 2002). This oasis consists of a palm grove, located on the terraces, with an area of around 40 hectares. The region belongs to the Saharan domain, located in the western part of the South Atlas depression. The Hamada, the Erg, the Reg, the

Montainsof Ougarta, the Valley of the Saoura, are terms for the immense expanses of the landscape of the arid model of this region (Bouaziz *et al.*, 2018).

The main key to this oasis is the date palm (*Phoenix dactylifera* L.). The date palm is an essential element in the agro-system of oases (Bouguedoura *et al.*, 2015). A lot of constraints are confronted in date palm farming against date palm in saoura region like salinity, boufaroua (*Oligonychus afrasiaticus: Arachnid, Tetranichidae)* and fusarium wilt named bayoud disease (*Fusariumoxysporum* f. sp. *albedinis*), (Djerbi, 2003; Benzohra *et al.*, 2015).

The objective of this review is to determine the typology of Saoura oasis, evaluate the agroecsystem of Sahara represented by the date palm cultivation and finally cite the varietal diversity of date palm.

## Geographic location

This study was carried out in Saoura oases, well knew by the administrative name 'Bechar' in (South-West groves of Algeria). This region has an altitude arrived at 850m and distributed between four principal valleys (in arabic: 'Oued' when the valley is without water).

## Climate

Saoura region is characterized by a continental desert type climate (Table 1), (Faci, 2019). There are two types of zones:

- ✓ The transition zone: This zone is bounded by Beni-Ounif region to the north and the parallel of Igli to the south. It's very hot in summer (more than 45°C) and harsh cold in winter (2°C to 3°C). The rainfall is around 60 mm/year. Sandy winds are frequent and often violent (100 km/h).
- ✓ The desert zone: it extends beyond Beni-Abbes, Kerzaz and OuledKhedir regions. Precipitation is in the order of 40 mm/year. Sandy winds are very frequent.


**Fig 1:** Geographical location map of Saoura province.

## Geology

The province of Saoura is made up of five (5) main reliefs:

- ✓ **Mountains:** Are very high without vegetation. Examples: Antarmountain (1953 m), Grouzmountain (1835m) and Becharmountain (1206 m).
- ✓ **Valleys:** There are principally four in this region: Bechar, Zouzfana, Guir and Saoura (Fig 2).
- ✓ **Regs (Hamada):** These are the vast expanse of rock. The most important are: Guir andDaoura.
- ✓ **Ergs:** They represent massive dunes that can reach up to 300 m in height. The existing ergs bear the name of: Grand Occidental Erg, Erraoui, El-Atchane Erg and also IguidiErg.

## Hydrogeology

The subsoil of this region contains significant groundwater resources. It closes a diverse and interconnected groundwater system of which the Saoura valley is considered to be the umbilical cord. The Saouravalley results from the junction at the level of Igli, of the Guir and Zouzfana valleys (Fig 2), (Merzougui *et al.*, 2007). The exploitable water resources in Saoura are:

- ✓ The ground water of the great western Erg, hydrogeologically well defined, it is integrated into a vast aquifer system, limited to the North by the South Atlas flexure, to the South East, it is balanced with the waters of the intercrop continental where this water is captured in Foggaras systems of irrigation (Fig 3). The latter one is fed by the northern valley, mainly by the valley of the Saharan Atlas. The large source, usually called "Sidi Othmane source", collects the groundwater from this aquifer, with a flow rate of 26 litres/s to 33 litres/s (Roche, 1973; Merzougui *et al.*, 2007), it ensures a double role, supply of alimenting water and irrigation of palm grove. It represents in this locality the outlet par excellence of this aquifer.
- ✓ The aquifer of Guir'sHamada, alimented by the rare meteoric waters whose aquifer corresponds to the lake limestone's of the Tertiary era. The aquifers of the Paleozoic formations are only known locally, in the regions of Zeghamra and Ougarta, whose aquifer is Cambrian and Ordovician eras. These aquifers are partially alimented by meteoric waters and the Saoura valley.

**Table 1:** Climatic data of month'stemperatures in last 26's years in Saoura province of Algeria.

| Months | Saoura's annual climates data | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Temperature minimalemoyenne (°C) | 1 | 4 | 8 | 12 | 16 | 21 | 25 | 25 | 20 | 13 | 7 | 2 |
| Temperature moyenne (°C) | 8 | 11 | 15 | 19 | 23 | 28 | 32 | 31 | 26 | 20 | 13 | 9 |
| Températuremaximalemoyenne (°C) | 15 | 18 | 22 | 26 | 30 | 35 | 40 | 38 | 33 | 27 | 20 | 16 |
| Precipitations (mm) | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 0 |

Source: Weatherbase, stats data collection of 26 years.

✓ The aquifers of the alluvial and lower-stream terraces constitute a particular type of aquifer, formed by the large spreading of sand and gravel (alluvial terraces) of the Saoura, known under the names of the Saourian (Upper Pleistocene) and of the Guirian (Holocene era).

## Pedology

Saharan soils witnesses the dominant factor of soil formation is the wind.But other authors consider the temperature and drought that cause the phenomenon of Saharan soil creation (Benchetrit, 2018). The formation of soils in the Saoura region is completely dominated by climatic conditions where the wind plays a predominant role. Aeolian soils of accumulation formed by small particles were carried by the wind which accumulates in sheltered areas forming more or less developed sand deposits: rehboub, nebka, dunes, up to the large Ergs. These accumulations of sand can climb along the slopes of the mountains and form more or less important sandy veneers (North of the Saoura), (Benchetrit, 2018).

The bedrock only intervenes here to differentiate the accumulated sand, but does not play any determining role in the genesis of the soil formed by the action of the wind. A profile studied in the Laghouat region can characterize the soils of these dunes. Well drained, without vegetation or culture, it is homogeneous over its entire thickness (4 to 5 m) and the red sand that constitutes it does not contain soluble


**Fig 2:** Valleys of Saoura province.


**Fig 3:** Modes of irrigation systems in saoura oasis. A: traditional system of irrigation called 'Foggara'; B: Farmer subdivides the water of Fouggara for his fields; C: Gravity irrigation system.

salts. The grain size reveals two maxima: at 0,3 mm (39.4%) and at 0,15 mm (37.4%), (Benchetrit, 2018).

## Oasis agrosystemic proprieties

When the Saoura region is an arid environment, it requires a lot of water to irrigate crops (Bhattacharya, 2009; Pawar *et al.*, 2015; Kumar *et al.*, 2019). Regarding the irrigation of palm groves and other crops, there is the system of draining galleries which is known around the world under several names. It's called Fouggara in Algeria (Fig 2), 'Khatarra' in Morocco, 'Kriga' in Tunisia, 'Kanat' in Iran, 'Falj' in Sultanate of Oman, 'Kariz' in Afghanistan and Pakistan, 'QanatRoumani' in Jordan and Syria and 'kanerjing' in China (Remini *et al.*, 2010).

This Saharan agroecosystem has several constraints, we can cite them by the following points:

- Salination of water and soil.
- Flooding by seasonal water erosion.
- Aeolian erosion due to the spring sand winds which favour certain date palm pests (mite: boufaroua '*Oligonychus afrasiaticus* Mc Gr.').
- Genetic erosion of old as well as new palm groves due to date palm bayoud, a soil-borne fungal disease caused by *Fusarium oxysporum* f. sp. *albedinis*, with the susceptibility of high-quality date varieties to this disease such as Feggous and H-mira (Mezouari *et al.*, 2019).
- Specificity of the region of saoura compared to others (Touat, Gourrara… *etc.*), by the migration of families who practice phoeniciculture to urban areas and change their jobs.

## Varietal diversity of date palm

Il est important pour dire que la diversité variétale de n'importe espèce cultivée reste la clé principale pour créer de nouvelles variétés ont des caractéristiques agronomiques (précocité, résistance aux ravageurs et maladies …), et pédoclimatiques (salinité, sécheresse, gelées, fortes chaleurs …), très appréciables (Sedra, 2005).

Despite the Algerian market in dates, it is important on the side of the oases of south-eastern Algeria (Ziban, OuedRigh and Souf), but the palm groves of the Saoura is also rich in terms of varietal diversity of the date palm with its distribution which is different in the palm groves of the region (Table 2), (Benzohra *et al.*, 2015). The most food and commercially important varieties likeFeggous and H-mira (Table 2; Fig 4). There are others but have poor nutritional qualities, but have other more important agro-ecological and genetic properties that can be used during plant breeding to transfer these check traits to the varieties to be selected (Benzohra*et al.*, 2015 ; 2017). We can cite the example of the variety called 'Taquerboucht' which has average food qualities but is resistant to Bayoud, a very threatening soil-borne disease caused by the fungus *Fusarium oxysporum* f. sp. *albedinis* (Benzohra *et al.*, 2015).

It is important to say that the varietal diversity of any cultivated species remains the main key to create new


**Fig 4:** Varietal diversity of date palm in Saoura oases.1: Adem Bulla; 2: Charka; 3: Feggous; 4: Figuig ; 5: Tinnaceur; 6: H-mira; 7: Taquerboucht; 8: Tamdjouhert.

**Table 2:** Presence/Absence of date palm varieties in different regions of saoura oases.

| *Names of date palm varieties | Saoura's oases regions | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Beni-Ounif | Bechar | Kenadsa Abadla | Lahmar Boukais Moghel | Taghit | IgliBeni -Abbes | Kerzaz | Ouled-Khedir |
| Feggous | + | + | + | + | + | + | + | + |
| H-mira | + | + | + | + | + | + | + | + |
| Figuig | + | + | - | - | - | - | - | - |
| Charka | - | - | + | + | + | + | - | - |
| Tinnaceur | - | + | + | + | + | + | + | + |
| Adem Bulla | - | - | - | - | - | + | + | + |
| Taquerboucht | - | - | - | - | + | + | + | + |
| Tamdjouhert | - | - | - | - | - | + | + | + |
| Hartan | - | - | - | - | - | + | + | + |
| Sbaa Sultan | - | - | - | - | + | - | - | - |

Source: ITDAS (Institut Technique de Développement de l'Agriculture Saharienne, Bechar, Algeria); *The information was collected from the technical institutes of the region (ITDAS, DSA) and also by the farmers of these regions. + : Présent in plam groves ; - : Absent in palm groves.

varieties with agronomic characteristics (precocity, resistance to pests and diseases ...) and pedoclimatic (salinity, drought, frosts, high temperatures …), very appreciable (Sedra, 2005).

## CONCLUSION

This article aimed to present the oasis agroecosystem of the Saoura region with its typological and agronomic properties and to determine the constraints that weaken it. TheSaoura region is a magnificent oasis, the crossroads of the cultures of the Mediterranean and the countries of Africa where the cultivation of the date palm is important.

In this agroecosystem, crop irrigation is based on the technique of collecting and distributing water known by the drainage galleries under different names such as Fouggara, kariz, qanat and khettara, is practiced in several arid and semi-arid countries. For several centuries,Saoura oases have a somewhat limited number of local varieties of date palm, but there are some quality varieties for this region (Feggous and H-mira).

For constraints, this agroecosystem has certain constraints such as salinity, drought, diseases and pests, which must be controlled to combat them in order to protect the backbone of the oasis agroecosystem: the date palm.

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**Conflict of interest:** None.

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