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Thème

State and phytosanitary quality of dates in stock in Ouargla region

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Awknoledges

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With all the eternal love and with the intensity of my feelings I dedicate this thesis to my dear family.

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Abbreviation	Meaning
Cc	Centimeter cube
IN	Individual Number
RA	Relative Abundance

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Introduction

Introduction

Date palm (*Phoenix dactylif*era L.) is the central crop and the suitable choice in arid and semi-arid areas of the globe. The dates are the source of economic income for the Saharan populations of the Middle East and Africa (Boufis et al., 2014). Due to its food, ecological, social and economic benefits, the date palm is the most valued fruit tree by oasis populations (Trichine, 2010). The potential distribution of date palm is in the South-East which hosts nearly 60% of the national heritage (Benaouda, 2012).

Its fruits constitute a fairly complete vegetal food, rich in nutrients, notably carbohydrates, minerals and vitamins, which are essentials for the proper functioning of the human body as well as animals (Bouna, 2002). The current situation of the Algerian phoenicultural patrimony is about 18,336,385 palm trees spread over an area of 160 000 ha, with an annual production of dates is equal to 500 000 tons (Bouguedoura et *al.,* 2019). The production of dates is consumed, for the most part, inside the country, as far as Algeria's exports of dates, officially declared, are estimated annually between 4 and 5% of the total national production (Zeddour, 2011).

The human being experiences a lot of difficulties to preserve his agricultural and nutritional products, at the level of the plantations and at the level of stocks. The percentage of worm-eaten Deglet Nour dates in North Africa is always high, varying between 10% and 30% (Lepigre, 1963). The failures are often due to the lack of a precise and detailed knowledge of the biology of these pests, which attack the stored products, reducing them and making them unfit for consumption, which causes serious problems for the exportation. A severe fight against the insects has been conducted for several centuries and the methods of control have been improving more and more (Lepigre, 1951).

In addition to all these losses, very little research has been performed on the possibility of ending this problem caused by certain pests. In the framework of determining the agents responsible for the damage to the stocks, our study puts in place a research that points out the pests of the stored dates in Ouargla as well as their predators that can be used in a possible biological control, which will undoubtedly guide and help the investors to better store their dates in safety without chemical treatment.

In a classical way, this work is exposed in three chapters. The first is focused on the generalities and the importance of the date palm and the dates, especially in stock. While the second chapter presents the study region Ouargla and the station of Ain Beida, accompanied by

the equipment and methods used in the field and laboratory, as well as the various ecological indices and statistical analysis used for data exploitation. As for the third chapter, it contains the obtained results which are interpreted and discussed along the way. Finally, a conclusion with perspectives closes the present study.

Chapter I
Bibliography

1. Bibliography

1.1 General Information on the Date Palm

The date palm is one of the most important plant families from a socio-economic point of view. Indeed, it constitutes the backbone of agriculture in the Saharan regions (Gourchala, 2015). The world production of date palm fruits (dates) is variable but of great economic importance (Aberlenc-Bertossi, 2012). It is a baie, generally of extended or rounded shape (Espiard, 2002).

It is formed by an edible part represented by the pulp whose shape, consistency, and color at maturity are variable according to the cultivars, and by a non-edible part formed by the core having a hard consistency, also variable according to the cultivars (Dowson and Aten, 1963).

1.2 Taxonomy

The date palm was named *Phoenix dactylifera* by Linné in 1734. The term *Phoenix* comes from *Phoinix*, the name of the date palm among the ancient Greeks who considered it as the tree of the Phoenicians.

The term *dactylifera* refers to the dactylus finger in Latin, deriving from dachel in Hebrew (Popenoe, 1938), because of the shape of the fruits (Linnaeus 1753; Munier 1973). It is classified systematically as the following (Munier, 1973):

Kingdom	Plantae
Division	Tracheophyta
Class	Magnoliopsida
Order	Arecales
Family	Arecaceae
Genus	*Phoenix* L.
Species	*Phoenix dactylifera* (Linné. 1753)

1.3 Dates Production in Algeria

Algeria is classified as one of the main date producing countries (4th in the world with 14% of world production (Bahloul, 2017). The production of dates in Algeria reached 12 million quintals in 2019, the Agriculture sector has achieved "an accomplishment" that is the labeling of "Deglet Nour" which is produced in the wilaya of Biskra, adding that other types of dates that are produced in other wilayas of the Great South (Omari, 2019).

The Algerian palm groves are located as the following (Tab. 1).

Table 1: Space of Algerian palm groves (Messar, 1996)

Region	**Superficie (%)**
South-east (Biskra, Ouargla and El Oued)	67
South-west (Bechar and Adrar)	21
South (Ghardaïa, Tamanrasset, Illizi and Tindouf)	10
Other	2

The southeast region (67%) has the largest surface area of date palm (Tab. 1). It is followed by the south-west region (21%) and the south (10%).

Table 2: Number of date palms in Algeria (MADR, 2002)

State	**DegletNour**	**Ghars**	**Deglat Beida**	**Total date palms**	**Number of palms in ratio**
Adrar	-	-	2 150904	2 904150	2 860071
Laghouat	8470	7650	11580	27700	12580
Batna	700	3900	21270	25870	25330
Biskra	1 964460	436530	748200	3 149190	5 802012
Bechar	5 650	-	-	770 030	360 150
Tamenrasset	2 940	-	-	417 140	167 760
Tebessa	49550	49550	10650	68970	25200
Djelfa	2 610	860	210	3 680	1 610
M'sila	-	-	18 000	18 000	14 000
Ouargla	1 092 330	783 750	193 130	2 310 069	1 130 667
El Bayed	-	45 900	0	193 130	22 500
Ilizi	2 250	16 340	73 030	91 620	49 930
Tindouf	350	24 250	-	24 600	3 200
El Oued	1 884 030	703 330	296 300	2 660 883	2 580 238
Khenchla	21 290	44 800	7 370	73 460	51 040
Naama	-	19 600	2 600	22 200	15 250
Ghardaia	377 100	154 400	378 900	910 400	631 600
Total	3 559 930	1 660 761	4 048 710	13 505 880	9 300 370

According to Table 3, nearly 58.1% of national production of dates is conducted by the two wilayas: Bisrkra (28.6%) and El Oued (29.5%). Deglet Nour occupies the 1st place and represents 52.9% of total production of dates.

1.4 Different Development Stages of the Date

The fertilized flowers, at the time of setting, give a fruit which grows in size, in consistency and in color until the product picking (Peyron, 2000). The date passes through stages of development, the names of these stages are different according to the date producing countries (Tab. 3). In total, 5 stages are noted, which begins with the Loulou stage and ends with the last stage called Tmar (Tidjani, 2005).

Table 3: Ripening stages of dates

Stage	**Stadge's name**
Stage I	Loulou
Stage II	Khalal
Stage III	Bser
Stage IV	Martouba
Stage V	Tmar

1.5 High Interest Cultivars

1.5.1 Deglat

The date cultivar selected in this study is widespread in the palm groves of the South-east region. The date Deglat at maturity, is rather beige in color tinged with a little noticeable brown. The epicarp is wrinkled, not very bright and easily broken. The mesocarp is not very pulpy of dry consistency and fibrous texture (Buelguedj, 1996).

The choice of this cultivar is based on its gustatory quality, its abundance on the national level and its facility of conservation.

1.5.2 Ghars

It is a very rustic cultivar which is found in the majority of the Algerian palm groves plantations. The mature fruit has a soft consistency. Its revenue varies between 60 and 70 kg/tree of good market value at the national level (Gourchala, 2015).

1.6 Physico-chemical Composition of dates

The documentation, during the last decades, has shown an important number of studies on the biochemical composition and nutritional value of dates (Yousif et *al*., 1976; Vandercook et *al*., 1977; Fayadh and Al-Showiman, 1990; Al-Hooti et *al*., 1997; Besbes et *al*., 2004). Sugars

and water are the major elements for the consistency of the pulp (Estanov, 1990). In this section, some biochemical date's characteristics are developed.

1.6.1 Water Content

The water content of dates evolves according to the stage of maturity (Tab. 4). The humidity decreases from the green stages to the ripe stages (Booij et *al*., 1992). It varies from one class to another, dates of soft consistencies have a humidity higher than 20%, on the other hand the dry dates have a humidity lower than 20% and the dates of semi-soft consistency have a humidity varying between 20-30% (Munier, 1973).

Table 4: Water content of some varieties of Algerian dates (Belguedj, 2002)

Dates class	**Cultivars**	**Stage maturity**	**Water %**
soft consistencies	Ghars	Tmar	25.4
semi-soft consistency	DegletNour	Tmar	22.6
dry	Deglat et Deglatbaida	Tmar	13.7

1.6.2 pH

Generally, the cultivars pH of dates varies depending on the stage of physiological development of the date (Dowson and Aten, 1963). In general, it is slightly acidic-variant between 5 and 6. This pH is prejudicial to bacteria but suitable for the development of fungal flora (Reynes et *al*., 1994).

1.6.3 Electrical Conductivity

Generally, the soluble salt contents vary according to the studied cultivars. Soil fertilization has an influence on its mineral composition (Hussein and Hussein, 1983). The electrical conductivity of dates expresses the content of the product in mineral matter (Djafour et *al*., 2005).

Chapter II
Materials & Methods

2. Materials and methods

The estimation of pest damage has been the focus of research specialists for a very long time. In order to conduct its study properly, a well-researched methodology and adequate equipment are of major importance in conducting this kind of study (Dorbane, 2016). In this chapter are detailed the material and methodology adopted for the study of stock pests in the region of Ouargla.

It is necessary to mention that our study was used on dates of 2020 with a frequency of two outings per month, for a period of time of 5 months (November to March).

2.1. Presentation of the study area

The present work is carried out in the Ouargla region (29° 13' to 33° 42' N; 3° 06' to 5° 20' E.), which is located at the bottom of a synclinal basin of the Oued M'ya valley (Rouvillois-Brigol, 1975). It is located about 800 km southeast of the capital (Fig. 1), covering an area of 163,233 km2. Geomorphologically, it is bounded to the north by Sebkhet Safioune, to the east by the Ergs El Touil and Arifdji, to the south by the ruins of Sedrata and the M'zab plateau to the west (Rouvillois-Brigol, 1975). Within this region, the station of Ain Beida is selected.

2.2. Description of the station of Ain Beida

The Ain Beida station (31° 56′ 19″ N, 5° 23′ 23″ E) is located 7km east of Ouargla (Fig. 2). It encompasses a total area of 177328.32 ha, with 132174 palm trees (CDARS, 2004). from the North, it is almost entirely surrounded by the palm groves of Ain Beida (Chott and Adjadja), from the South by Hassi Messaoud, from the East by El Borma and from the West the city of Ouargla. It is also crossed by the drainage network of water to the outside of the basin and the road network (Hacini and Zatout, 2012).

Within this station, 3 locations of date stocks are selected.

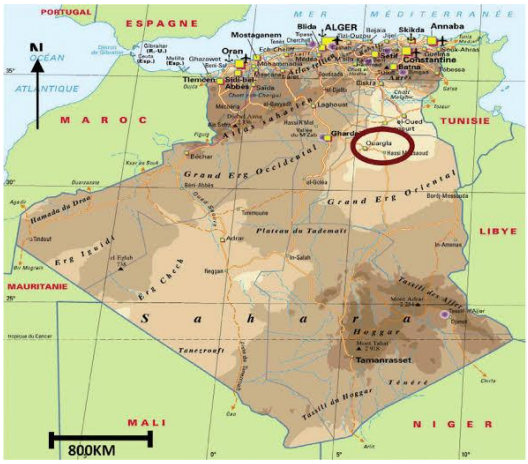

Figure 1: - Location of the Ouargla region (Koull and Hlilat, 2015)

Figure 2: Location of Ain Beida (image google maps 25/05/2021)

2.2.1. Stock1

Stock 1 is a garage of 10x10m², with a height of 5m, where the dates are kept in superposed crates, covered by a tarpaulin (Fig. 3). They are stored for a period of time ranging from August to March. The dates are intended either for human consumption (good quality) or for livestock (bad quality). It is a small location of stock used for the sale and purchase of local production (Ouargla).

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Figure 3 : Picture of stock 1

2.2.2. Stock 2

Stock 2 is a garage of 8x15m², with a height of 6m. The dates are stored in crates on top of each other in one side (Fig. 4A) and on the ground in the other side (Fig. 4B). The space is semi-open, which allows animals (birds, poultry, rats, etc...) to easily access the stock (Fig. 4B). The dates are stored throughout the year. They are intended either for human consumption or for livestock. Part of this stock is exported to nearby countries in South Algeria.

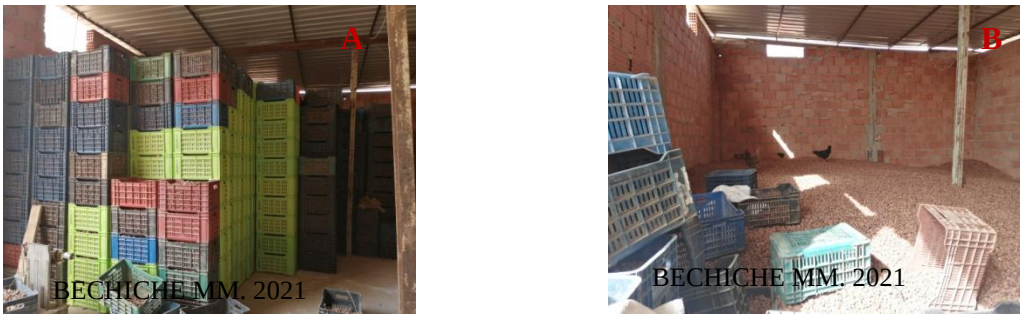


Figure 4 : Picture of stock 2

2.2.3. Stock 3

The stock 3 is a garage of 20x20m², without roof (open air). The dates are stored in crates, on the ground or in refrigeration rooms, which are located nearby (400m). They are stored in an unsteady way because of the continuous sale to the international market. The dates in the cold rooms can be stored for almost a year.

2.3. Justification of the choice of cultivars

Considering the existence of a large number of cultivars of dates in Algeria, the choice of cultivars for the realization of this work has required a considerable amount of reflection. The cultivars of the selected dates in this study are common in the palm groves of the South-East region, those cultivars are Ghars and Deglat. They present the most conserved dates in stock given their sustainable usage throughout the year (Gourchala, 2015).

Dates in stock are known to be attacked by stock pests, which gives us a valid reason to conduct this study (Idder et *al*., 2009)

2.4. Dates study

With the different methods that were used for the samples collection, the study of morphological and physico-chemical characterizations, are exposed in this part.

2.4.1. Sample Collection

For date sampling, the mixed sampling method is the one used in this study, it is represented as a combination of the two methods, the first one is the judgmental sampling (non-probabilistic) and simple aleatory sampling (probabilistic).

2.4.1.1. Judgmental sampling

Also called subjective sampling method. Judgmental sampling consists of taking a sample based on certain judgments about the whole population. The sample is exposed to the researcher's prejudices (Elect. Ref. 1).

Each outing, the crates that are chosen are highly exposed to pest's attacks (rodents, insects...).

2.4.1.2. Simple aleatory sampling

In simple aleatory sampling, each member of the population has an equal chance of being included in the sample (Ref. Elect.1).

The crates that were selected by the judgmental sampling method are taken into consideration to randomly chose a batch of 1.5kg of dates for the 2 cultivars (Ghars and Deglat) from. The objective is to have an idea on the infestation state of the stored dates in stock.

2.4.2. Pest collection methods

For the collection of insect pests, 3 collecting methods were used, including manual capture, capture with a gauze and recuperation of pests inside the dates after opening of course.

2.4.2.1. Manual capturing

Manual capturing is an excellent technique for conducting inventories of large marge of species that can be easily identified on the field or for complementing sampling with traps (Gasmi, 2011; Noblecourt et *al*., 2012). It consists of the hand capture of insect pests found in batches of dates, which are well excavated at the laboratory level.

2.4.2.2. Capture with a gauze fabric

In the laboratory, each batch of dates is covered by a gauze cover, which is used to block insects, especially Lepidoptera, from emerging out of the infested date batches (Fig. 5). Each day the set-up is checked to recuperate the pests for their determination and classification.

Figure 5: Arrangement of dates in stock covered by a gauze fabric

2.4.2.3. Inventory of pests found inside the dates

In this part of the process, each date is opened with a cutter (Ghars) or a pair of forceps (Deglat) to note the state of infestation and to recuperate the larvaes that are inside the wormed dates.

2.4.3. Attack rate of dates in stock

For the loss detection of the stored dates, we were based on the criteria of aleatory selection (simple aleatory method) of some dates (Ghars and Deglat) in each study location.
The attack rate is calculated using the following formula:

$$T\% = \frac{Da}{Dt} \times 100$$

Da: number of attacked dates;
Dt: Total number of dates

2.4.4 Identification of pests inventoried in the study stations

After collecting insect species from the different batches of dates, each individual is spread out under a binocular scope for the counting and determination of the captured species. The determination keys used are Leclant (1978), Wolfgang (2009) and Bernard (2011).
The determination of the collected insects is based on the morphological aspect such as, pigmentation and the abdomen ornamentation, the color and the body length, the shape and the length of the antennas, the venation of the wings especially the median nervures, the bifurcation, the shape of the tail and the number of the caudal bristles.

2.4.5 Biometric Characterisation of Dates

In this section, the date biometry is examined using a 0.1g precision electric scale (Fig. 6A) to measure the weight and a 0.01mm precision caliper to measure the high dimension (Fig. 6B) and length of the date (Fig. 6C).

A. Weight measuring B. High dimension measuring C. Lenth measuring

Figure 6: Different biometric measures of dates

It is necessary to mention that for the biometric measurements, a total of 30 dates, of each cultivar (Ghars and Deglat) and for each outing, is selected in a random way. The objective is to detect and characterise the infested dates compared to the healthy ones.

2.4.6. Physico-chemical study

The physico-chemical analyses that are managed in this part are water content, pH and electrical conductivity. The objective of this study is to compare these characteristics between the attacked and non-attacked dates to see if the attacks have an effect on the quality of the date.

2.4.6.1. Water content determination

The principle and procedure of the water content determination method are given in the following.

2.4.6.1.1. Principle

The water content is determined on a 1g portion of the sample spread in a porcelain container and dried in an incubator (or an oven) at atmospheric pressure of a temperature 103±2°C (Noui, 2007).

2.4.6.1.2. Operating mode

This method consists in choosing 3 dates not attacked as witness dates and 3 dates attacked, for the 2 cultivars, removing the cores, weighing them and putting them in the incubator (or an oven) at a temperature of 105°C for 15 minutes. After the temperature has cooled down, each sample is weighed. This manipulation is repeated 3 times every 1h and then every 30mn until the weight stabilises for the cultivar Ghars (Fig. 7A & B) and Deglat (Fig. 7C & D).

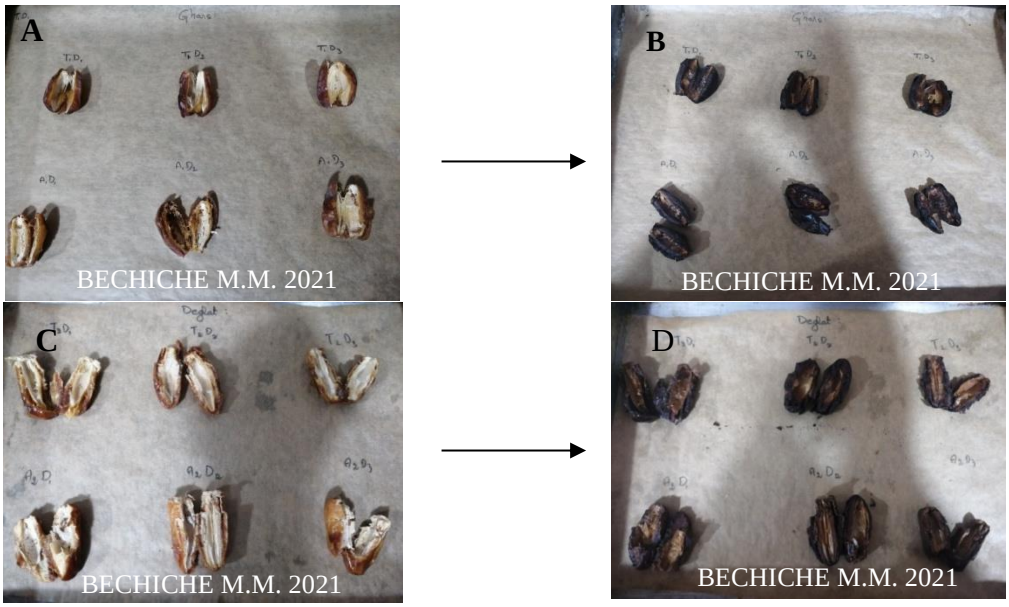


Figure7: Dates before and after drying

Lastly, the water content is calculated according to the following formula (Noui, 2007):

$$H\% = \frac{(M1 - \mathrm{M2})}{M1} \times 100$$

H% = Humidity;
M1 = Humid weight;
M2 = dried weight.

2.4.6.2. pH Determination

The principle and operating mode of the pH determination method are given in the following.

2.4.6.2.1. Principle

It is the determination in pH unit of the potential difference existing between 2 glass electrodes prolonged in an aqueous solution of the crushed date pulp (Noui, 2007).

2.4.6.2.2. Operating mode

This method consists of selecting 3 unattacked dates as witness dates and 3 attacked ones, for the 2 cultivars (Ghars and Deglat), removing the cores, cutting them into small pieces and placing them in a beaker, then adding 50cc of distilled water (Fig. 8) and finally placing them in a water bath (Fig. 9) for 30 min while stirring from time to time with a glass stick. Then the mixture is crushed in a mortar and the determination is proceeded, taking care that the electrode is completely immerged in the solution (Fig. 10).

Figure 8: Dates cut into small pieces

Figure 9: Beakers inserted in a water bath

Figure 10: pH measurement using a pH meter

2.4.6.3. Electrical conductivity determination (EC)

The principle and the operating procedure of the method for the determination of the electrical conductivity are given in the following.

2.4.6.3.1. Principle

The electrical conductivity of dates expresses the content of mineral content in the product, it is expressed in µS / cm after rinsing the electrode with distilled water. It should be pointed out that the value of the temperature of the solution to be analyzed is taken into consideration at the same time of the measurement of conductivity (Djafour et *al.*, 2005).

2.4.6.3.2. Operating mode

A weight of 10g is taken from a crushed mixture of 3 non-attacked dates (witness) and 3 attacked dates, separately. They are placed in a beaker, added with 50cc of distilled water

(Fig. 11). Then we proceed to the determination of conductivity taking care that the electrode is completely immerged in the prepared solution (Fig. 12).

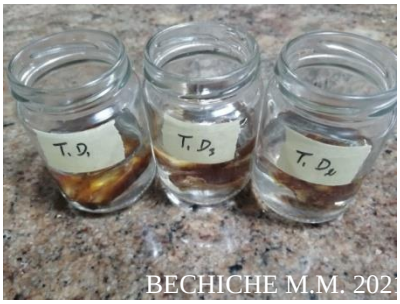


Figure 11: Dates immerged in distilled water

Figure 12: EC measurement using a conductivity meter

The conductivity is measured with a conductivity meter using the following formula:

$$EC\ (\mu S / cm) = \text{measured EC} \times F$$

F: Is the temperature correction coefficient;
CE: Electrical conductivity.

2.4.7 Simulation test of favorable conditions for pest installation in storage locations

This experiment is realized with the aim of revealing some favorable conditions for the installation of the pests at the level of the stocking locations.

2.4.7.1 Water dates submersion

Dates are transported on the national and international level, in climatic conditions (humidity, rain..) and very particular storages in order to preserve them. The main idea is to demonstrate the effect of the humidity of the date on the pest's installation.

To conduct this experiment, 5 dates of each cultivar are chosen randomly and submerged in water, for 1h, 12h and 24h (Fig. 13). After the soaking period, each batch is placed in a container carrying the necessary information (date, duration of soaking, cultivar...), without any cover (Fig. 14). Each day the containers are inspected to note any changes in the appearance and the installation of pests.

Figure 13: Dates submerged in water

Figure 14: Exposed dates in a storage place

2.5 Results exploitation

In order to explore the results obtained in this study, ecological indices and statistical analyses are used.

The results of the analyses, performed on the 2 cultivars Ghars and Deglat in the 3 stock locations studied in the region of Ain Beida, are expressed in means, median and variability between the dates cultivars. The variability is determined by ANOVA and Kruskall-Wallis test, which are performed using Statistica (V6). The significance level used is $\alpha < 0.05$. To check the reproducibility of the results, all experiments will be performed in three trials.

In addition, it is also used the index of the relative abundance that is presented below.

2.5.1. ANOVA test

The ANOVA test is a parametric test used for normal data. It allows us to test the existence of an effect of a factor and/or the existence of an interaction on several factors by comparing the means or variances. If one or the other of these tests rejects the hypothesis of non-existence of an effect, it is then necessary, in a second step of the analysis, to estimate the expectations of which the set describes the effects of the two factors as well as their interaction

(Dress, 2007). It is used in our case to test the differences between the tested parameters (e.g. attacked and non-attacked dates) and on the repetitions as well.

2.5.2. Kruskall-Wallis test

The Kruskall-Wallis is a non-parametric test, used when the data are not normal, to compare the distributions of several samples statistically. It works, not from the precise values observed, but from the ranges of these inter-classified values (Dress, 2007).

2.5.3. Relative abundance (RA%)

It is the ratio in % between the number of individuals (Ni) of a category (species, class, order) compared to the total number of individuals of all species (N) (Faurie et *al*. 2003). It is given by the following formula:

$$AR\% = \frac{Ni}{N} \times 100$$

RA%: Relative Abundance;
Ni: Number of individuals of the species (i) encountered;
N: Total number of individuals of all species.

Chapter III

Results & Discussions

3. Results and discussions

The present chapter details the results obtained (pests and their predators, damage estimation and impact of pests on morphological and physio-chemical characteristics of dates) following from the study of stored date's pests and their predators in the station of Ain Beida (Ouargla). They are accompanied on both sides by discussions on comparisons with the study and research done by other authors and researchers, having touched the same thematic or close to it.

3.1 Stored dates pests and their predators

In this section, the lists and numbers of insects found in the batches of dates collected from the different stock locations are presented.

3.1.1 Global list of insects found in stored date batches

Table 5 includes all the insects inventoried in the 3 stocking locations in Ain Beida.

Type	Class	Order	Family	Genus	Species
Predator	Insecta	Hymenoptera	Braconidae	*Cotesia*	*Cotesia flavipes*
				Apanteles	*Apantele splutellae*
				Phanerotoma	*Phanerotoma kozali*
			Pteromalidae	*Anisopteromalus*	*Anisopteromalus calandrae*
Pest		Coleoptera	Tenebrionidae	*Tribolium*	*Tribolium castaneum*
			Silvanidae	*Oryzaephilus*	*Oryzaephilus surinamensis*
			Dermestidae	*Dermestes*	*Dermestes ater*
			Nitidulidae	*Carpophilus*	*Carpophilus hemipterus*
		Lepidoptera	Pyralidae	*Apoomyelois*	*Apomyelois ceratoniae*
				Ephestia	*Ephestia kuehniella*
		Diptera	Drosophilidae	*Drosophila*	*Drosophila melanogaster*
			Cecidomyiidae	*Lestremia*	*Lestremia cinerea*

The sampling carried out by the use of different sampling methods in the three studied stocking sites, allowed us to identify 2 groups of insects (Tab. 5), the depredators (8 species) and their predators (4 species). Both have a total of 4 orders, the predators are represented with only one order Hymenoptera, and the depredators are divided into 3 orders, which are Coleoptera, Lepidoptera and Diptera (Tab. 5).

The families encountered in this inventory are a total of 9 families (Tab. 5), the families Braconidae and Pteromalidae are distinguished, which belong to the predator type, while among the depredators, Pyralidae, Tenebrionidae, Silvanidae, Dermestidae, Nitidulidae, Cecidomyiidae and Drosophilidae are distinguished (Tab. 5).

3.1.2 Number of the collected species

Table 6 presents the total number and relative abundance (%) of insect species caught in the 3 stocking sites in Ain Beida.

Table 6: Number and relative abundance (%) of the inventoried insects in the 2 studied cultivars

	Ghars		Deglat	
Species	**IN**	**RA (%)**	**IN**	**RA (%)**
Cotesia flavipes	93	28,79	100	25
Apanteles plutellae	30	9,29	19	4,75
Phanerotoma kozali	1	0,31	4	1
Anisopteromalus calandrae	-	-	3	0,75
Tribolium castaneum	1	0,31	1	0,25
Oryzaephilus surinamensis	98	30,34	48	12
Dermestes ater	1	0,31	1	0,25
Carpophilus hemipterus	-	-	2	0,50
Apomyelois ceratoniae	78	24,15	136	34
Ephestia kuehniella	20	6,19	83	20,75
Drosophila melanogaster	1	0,31	1	0,25
Lestremia cinerea	-	-	2	0,50
Total	323	100	400	100

-:Absence. IN : individual number ; RA : relative abundance.

The sampling realized by the use of different sampling methods in the three studied stock locations, allowed us to distinguish 12 species, where the pests are the most responded on the 2 studied cultivars (Tab. 6). In terms of species, the most important ones are *Apomyelois ceratoniae* (34% in Ghars; 24.1% in Deglat), *Oryzaephilus surinamensis* (12% in Ghars; 30.3% in Deglat) and *Ephestia kuehniella* (Ghars = 20.8%; Deglat = 6.2%).

For predators, the most noted species on the 2 cultivars studied was *Cotesia flavipes* (25% at Ghars; 28.8% at Deglat).

3.2 Estimation of pest damage and its impact on the characteristics of stored dates

This section focuses on pest damage and its impact on the biometric characteristics of stored dates.

3.2.1 Attack rate of dates in stock

In Table 7 are presented the attack rates of stored dates based on the studied cultivars.

Table 7: Attack rate of the studied cultivars according to stock locations

	Attack rate (%)		
Cultivars	**Stock 1**	**Stock 2**	**Stock 3**
Deglat	21	50	42,27
Ghars	21	26,40	15,91

The attack rates noted for the two cultivars (Deglat and Ghars) vary from one stock to another (Tab. 7). For the cultivar Deglat, it varies between 21 and 50%/ while for the cultivar Ghars, the rates vary between 15.9 and 26.4%.

In Table 8 the attack rates of stored dates according to the batches studied are presented.

Table 8: Attack rate of pests on the studied date cultivars according to the batches

Cultivars	**Deglat**			**Ghars**		
T (%)	**Stock 1**	**Stock 2**	**Stock 3**	**Stock 1**	**Stock 2**	**Stock 3**
Batch 0	31	53	31	31	31	31
Batch 1	30	50	43,3	30	30	3,33
Batch 2	10	60	46,67	10	30	33,3
Batch 3	16,67	46,67	46,76	16,67	20	13,33
Batch 4	20	46,67	70	20	23,33	26,67
Batch 5	10	40	-	10	13,33	-
Batch 6	20	-	-	20	-	-
Batch 7	6,67	-	-	6,67	-	-

The attack rates noted for the batches of the studied cultivars (Deglat and Ghars) in the 3 stock locations, vary from one batch to another (Tab. 8). Generally speaking, it was observed that the most attacked lots were the lots of the cultivar Deglat compared with the lots of the cultivar Ghars, and especially the lots of the 2nd stock with a rate equal to 60% (Tab. 8).

3.2.2 Biometric analysis of dates

Biometric characteristics are one of the important parameters closely linked with commercial quality and consumer requirements, which directly influence the offer and demand. Indeed, they play a major role in the determination of possible causes of attack. Furthermore, the results obtained in this part are presented in Figure 15, comparing the characteristics of the 2 cultivars Deglat and Ghars.

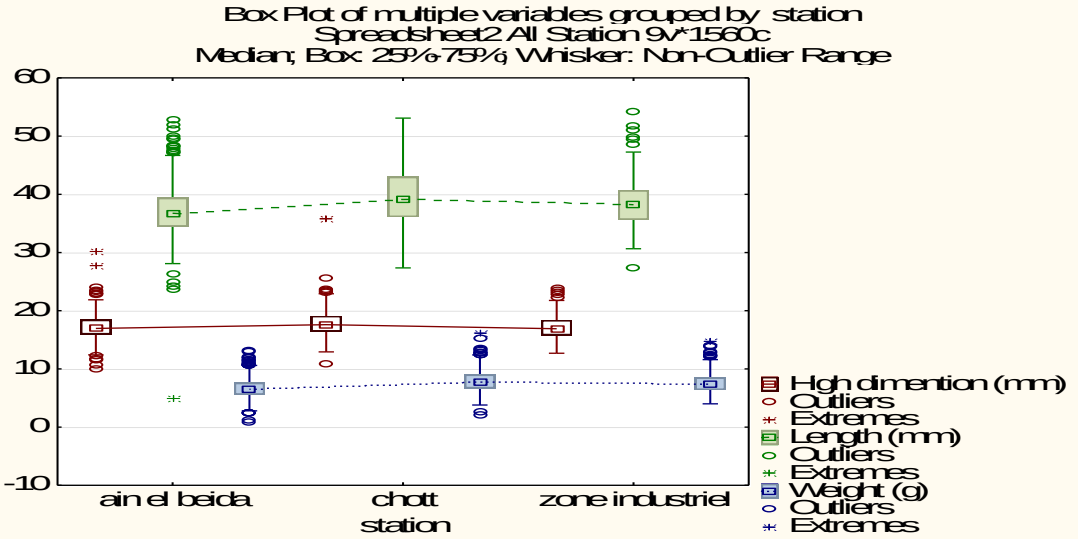


Figure 15: Box plot of biometric variables grouped by the different stock locations

The comparison with the ANOVA test between the 3 stock locations according to the biometric parameters shows a very highly significant difference ($p < 0.000$). It is observed that stock 2 is the place that contains the biggest dates compared to stock 1 and 3, with a mean equal to 17.7±2.1mm (max= 35.8mm, min= 10.9mm) of high dimension, 39.6±4.5mm (max= 53mm, min= 27.4mm) of length and 7.9±2g (max= 16.2g, min= 2.2g) of weight. While stock 1 has a mean 17.2±2mm (max= 30.1mm, min= 9mm) of large diameter, 37.1±1.7mm (max= 52.9mm, min= 23.7mm) of length and 6.6±1.7g (max= 13.2g, min= 0, 9g) and 3rd stock has a mean equal to 17.1±1.8mm (max= 23.8mm, min= 12.7mm) in large diameter, 38.4±3.8mm (max= 54.3mm, min= 27.4mm) in length and 7.6±1.7g (max= 14.8g, min= 4g) in weight.

In figure 16 presents the different parameters studied (high dimension, length and weight) according to the 2 cultivars studied Ghars and Deglat.

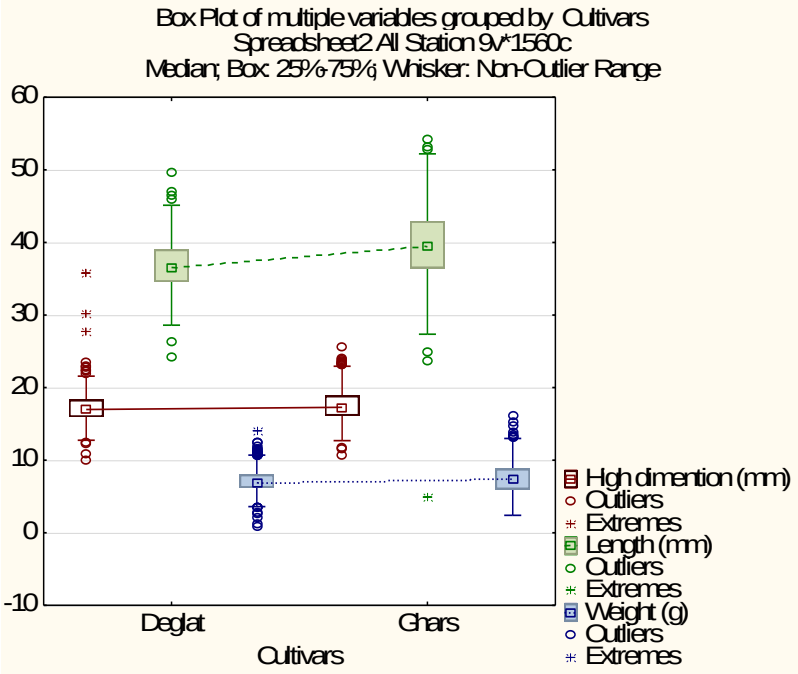


Figure 16: Box plot of biometric variables grouped by cultivars Ghars and Deglat

The comparison using the ANOVA test between the two cultivars Ghars and Deglat according to the biometric parameters shows a very highly significant difference ($p < 0.000$). The cultivar Ghars is characterized by a high dimension of mean equal to 17.5±2.1mm (max = 25.5mm, min = 10.7mm), a length of mean of 39.7±4.8mm (max = 54.3mm, min = 5mm) and a weight of mean 7.5±2.2g (max = 16.2g, min = 2.4g). While the cultivar Deglat is characterized by a mean of high dimension equals to 17.2±2mm (max = 35.8mm, min = 9.9mm), mean length 36.8±3.4mm (max = 49.6mm, min = 24.2mm) and mean weight 7.1±1.5g (max = 14.1g, min= 0.9g).

Discussion

According to Belguedj (2002), a date of Deglet Nour has a mean length of 60 mm and a diameter of 18mm. Moreover, the study conducted by Sayah and Ould El Hadj (2010), on the same cultivar, shows that these dates have a mean length of 41.1 cm. Comparing these values with our results, we find that all the dates studied present dimensions lower than the values indicated by these last authors.

On the other hand, our results are superior to those obtained by Haddou (2015) who indicated that the average length of the same cultivar is equal to 31.1mm with an average diameter of 15.3mm. Munier (1973) reports that a Deglet Nour date of good market quality has an average weight of 10 g. The results obtained in the present study show that the weight of all the studied dates is lower than the value indicated by the author. According to Ben Abdallah (1990), the quality of irrigation water seems to have a direct effect on the growth of date palm fruits and their weight.

Açourene and Tama (2002) and Babahani and Bouguedoura (2004), state that chiseling and restriction provide an augmentation in the weight of dates of the Deglet Nour cultivar. These differences may be related to the influence of climate, the quality of soil and water used in irrigation, and the care of the bunches and the palm (Haddou, 2015).

Figure 17 presents the biometric parameters of the different studied cultivars according to the batches of dates.

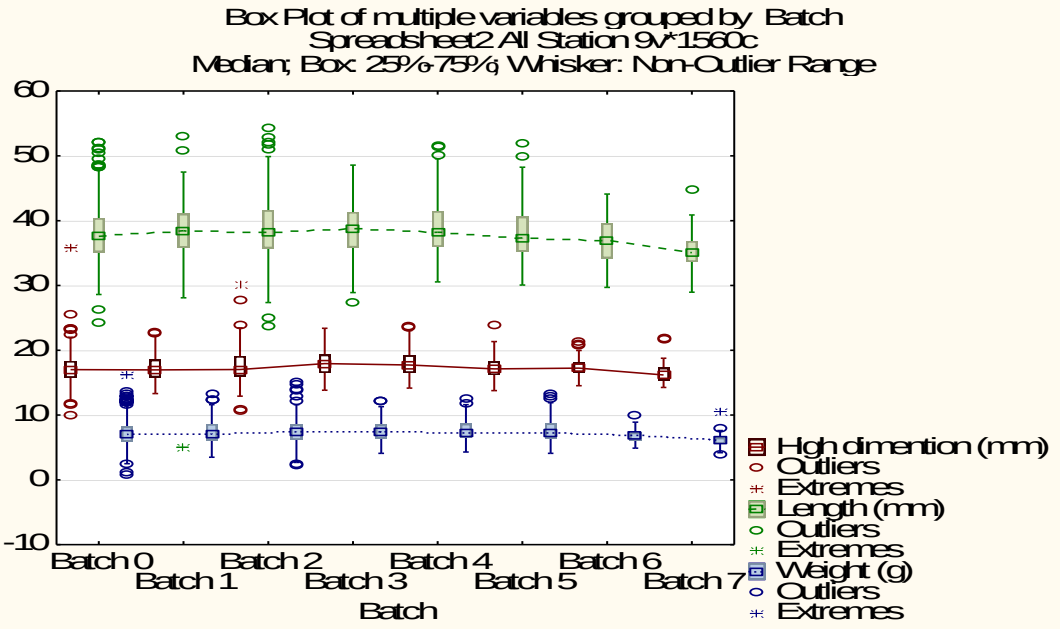


Figure 17: Box plot of biometric parameters of the different studied cultivars according to batches

The biometric characteristics of the dates vary depending on the lots (Fig. 17). The highest values are recorded in the first batches (Lots 1 to 4), while low values characterize the last batches (Lots 6 and 7). So we can say that the more the dates are stored the more their biometric properties decrease.

Figure 18 presents the biometric parameters of the different studied cultivars according to the infestation status of the dates (attacked or not attacked).

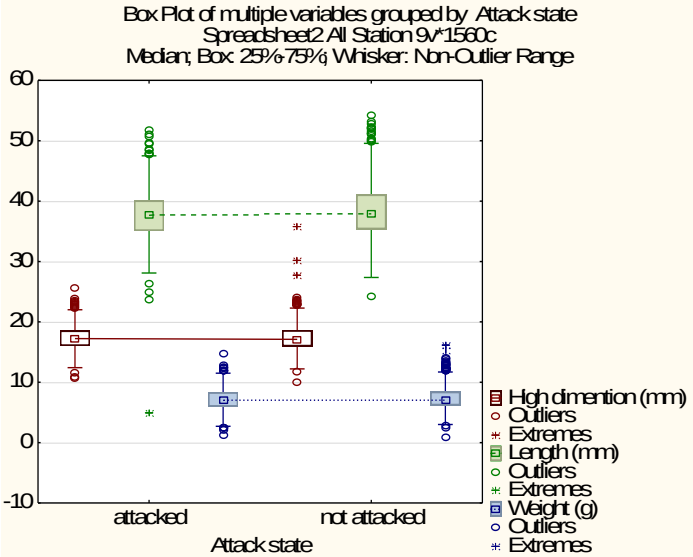


Figure 18: Box plot of biometric variables grouped by the attack status of both, Ghars and Deglat

The comparisons between biometric data with ANOVA test according to date attack status shows that there is no significant difference between high dimension ($p < 0.779$), length ($p < 0.011$) and weight ($p < 0.115$) measurements of attacked and non-attacked dates.

The attacked date cultivars are characterized by a mean large diameter and length of, 17.5±2.1mm (max = 30.1mm, min = 10.7mm) and 17.9±4.4mm (max = 51.8mm, min = 5mm), respectively (Fig. 18). And the non-attacked dates have a mean large diameter of 17.2±2mm (max = 35.8mm, min = 10mm) and length of 38.4±4.4mm (max = 54.3mm, min = 27.4mm). For the weight parameter, the values of attacked and non-attacked dates are very close and near 7.3±1.8g (Fig. 18).

Figure 19 presents the results of the attack status of the studied cultivars (Ghars and Deglat) in function of time.

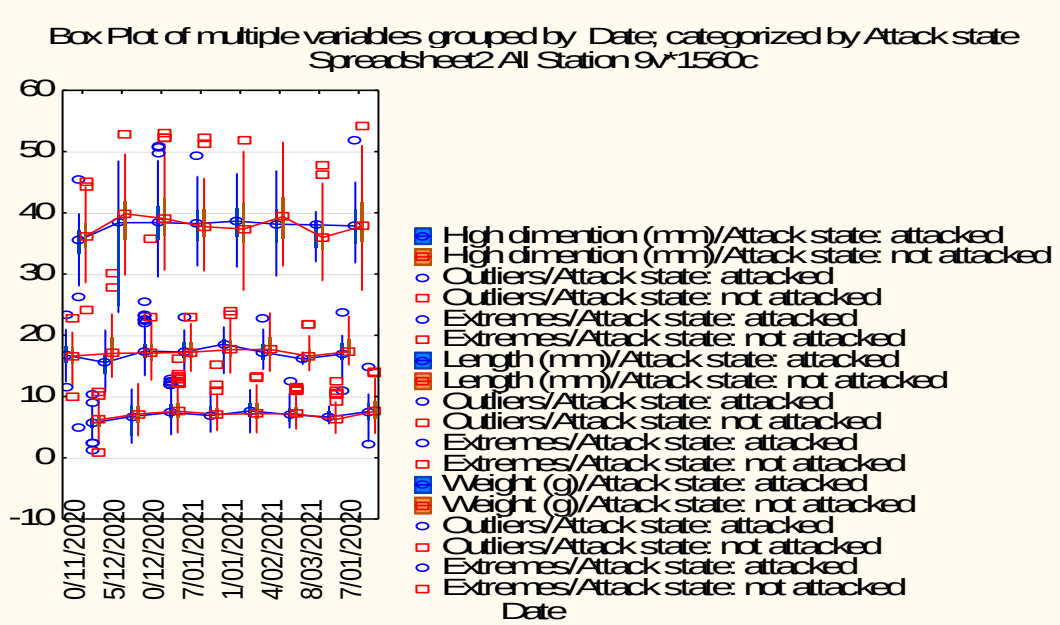
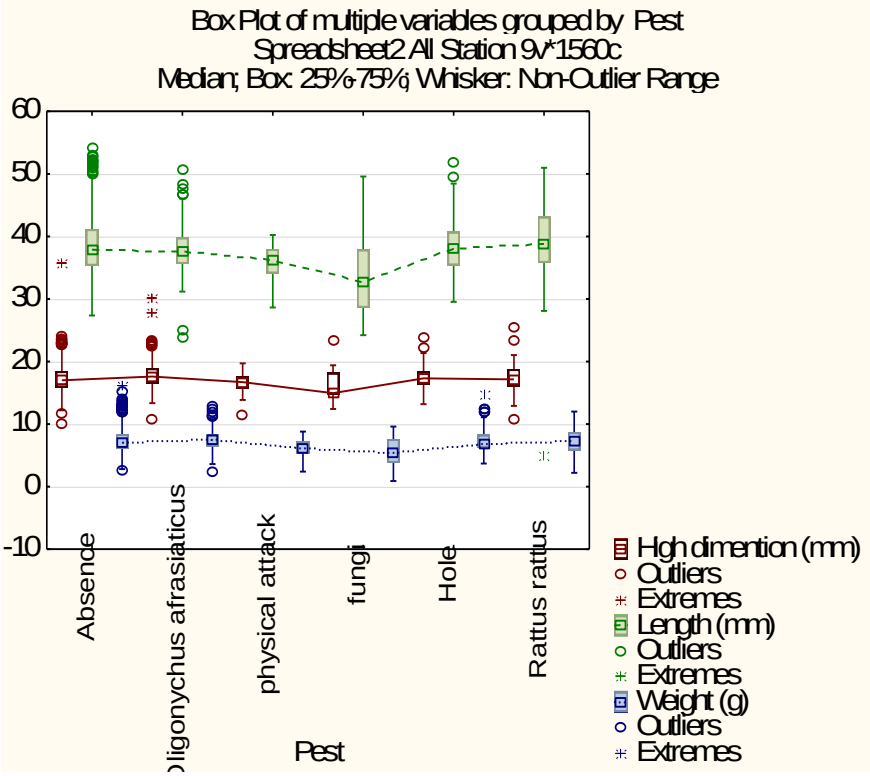


Figure 19: Box plot of biometric variables of attack status of the studied cultivars (Ghars and Deglat) in function of time

Using ANOVA test for comparison between biometric data and attack status shows the existence of a very highly significant difference ($p<0.000$) between the date sizes. The 4th batch which was taken in January 17, 2021 (Fig.19) is the most attacked with dates of higher size based on high dimension (17.9±2mm; max = 23.6mm; min = 14.2mm). Moreover, it is observed that the length of dates decreases according to the dates, the 7th batch taken on March 8, 2021 includes the dates of low caliber (16.5±1.5mm; max= 21.9mm; min= 14.5mm) comparing to the other batches. The same is valid for length (35.3±2.6mm; max= 44.8mm; min= 29mm) and weight (6±0.9g; max= 10.6g; min= 4g).

In figure 20, all the biometric parameters are presented according to the pests.



Hole represents the attack of *Apomylois ceratoniae* 's larvae

Figure 20: Box plot of biometric variables grouped by pest species

The comparisons between the biometric data with the ANOVA test according to depredators and their impact on dates shows that there is a very highly significant difference between the measures of high dimension ($p < 0.001$), length ($p < 0.000$) and weight ($p < 0.000$), of attacked and non-attacked dates (Fig. 20).

Dates attacked by *Oligonychus afrasiaticus* (in the field) are characterized by a high dimension of 17.7±2.1mm (max = 30.1mm, min = 10.7mm; Fig. 20) mean, a length of 37.9±3.7mm (max = 50.8mm, min = 23.7mm) mean and a weight of 7.4±1.7g (max = 12.9g, min = 2.4g) mean.

It is observed that Fungi attack the dates that have a small size, characterized by a high dimension mean of 16.3±3.3mm (max = 23.5mm, min = 12.4mm; Fig. 19), a mean length of 34±7.5mm (max = 49.6mm, min = 24.2mm), and mean weight of 5.3±2.8g (max = 9.6g, min = 0.9g).

Unlike Fungi, *Rattus rattus* attack the large dates, where their mean high dimension is 17.3±2.6mm (max = 25.5mm, min = 10.9mm; Fig. 19), mean length 38.9±7.2mm (max = 51mm, min = 5mm) and mean weight 7.3±2.4g (max = 12g, min = 2.2g).

Furthermore, *Apomylois ceratoniae* is noted in dates with a high dimension of 17.4±1.8mm (max = 23.8mm, min = 13.2mm), a length of 38.3±4.3mm (max = 51.8mm, min = 29.6mm; Fig. 19), and a weight of 7.4±1.8g (max = 14.8g, min = 3.7g).

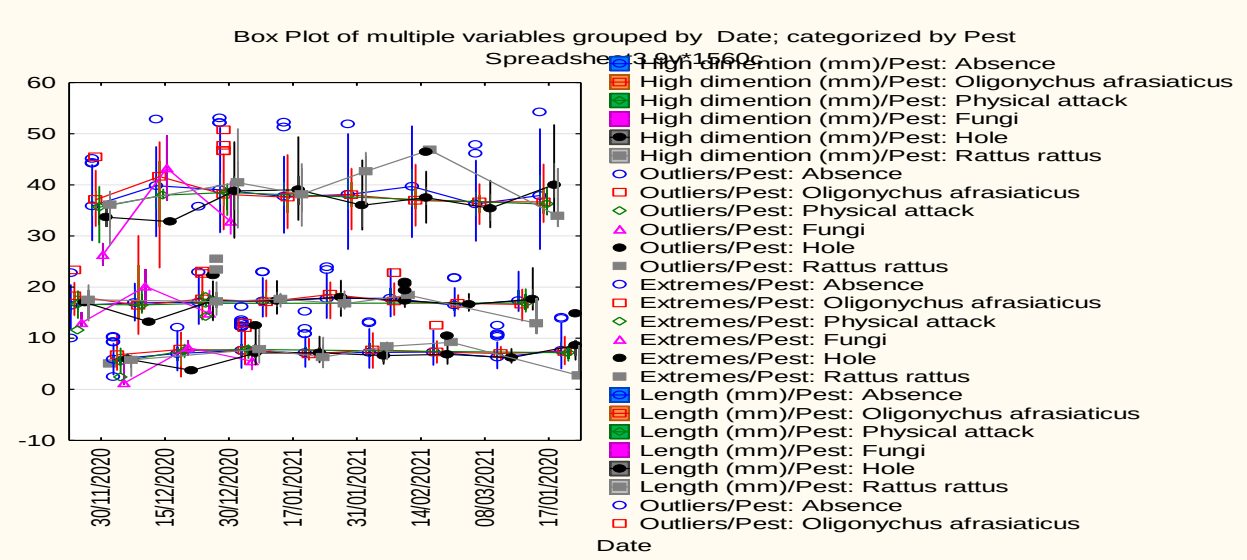
Finally, for non-attacked dates, they have a high dimension of 17.2±2mm (max = 35.8mm, min = 10mm; Fig. 19), length of 38.4±4.4mm (max = 54.3mm, min = 27.4mm) and weight of 7.4±1.9g (max = 16.2g, min = 2.5g) means.

Discussion

For the results of the present study, it should be mentioned that the attacks of Boufaroua are done on the field and not in the stock locations. The dates that are attacked by this pest show light and harsh patches as a result of its punctures and stings. The results obtained in this study are in agreement with Dakhia et *al*. (2013), who cite that *Oligonychus afrasiaticus* attacks all cultivars except the early matured ones.

Idder et *al*. (2009) showed that, the date moth *Apomylois ceratoniae* attacks the dates based on their size, which shows that this pest selects its dates with a certain preference. So we can say that the results announced in figure 20 confirm the results of this last author. *Apomylois ceratoniae* adapts its size to the size of the attacked date, meaning that if it attacks the dates of large caliber, the date moth will have a larger size while if it attacks dates with smaller caliber, it will also have a relatively small size.

The figure 21 displays the results of the types of attack according to the sampling dates.



Hole : represents the attack caused by *Apomylois ceratonia.*

Figure 21: Box plot of attack variables categorized by pests

The ANOVA test shows that there is no difference in injuries (physical attacks), *Oligonychus afrasiaticus* and *Rattus rattus* in function of dates ($p<0.127$). On the other hand,

the attack of *Apomylois ceratonia* presents a very highly significant difference ($p<0.000$) according to the dates of sampling where we observe that the most attacked dates are the most stored dates taken on March 8, 2021 and the least attacked dates are the least stored dates taken in December 30, 2020.

Figure 22 shows the results of the difference between attacked and non-attacked cultivars based on sampling dates.

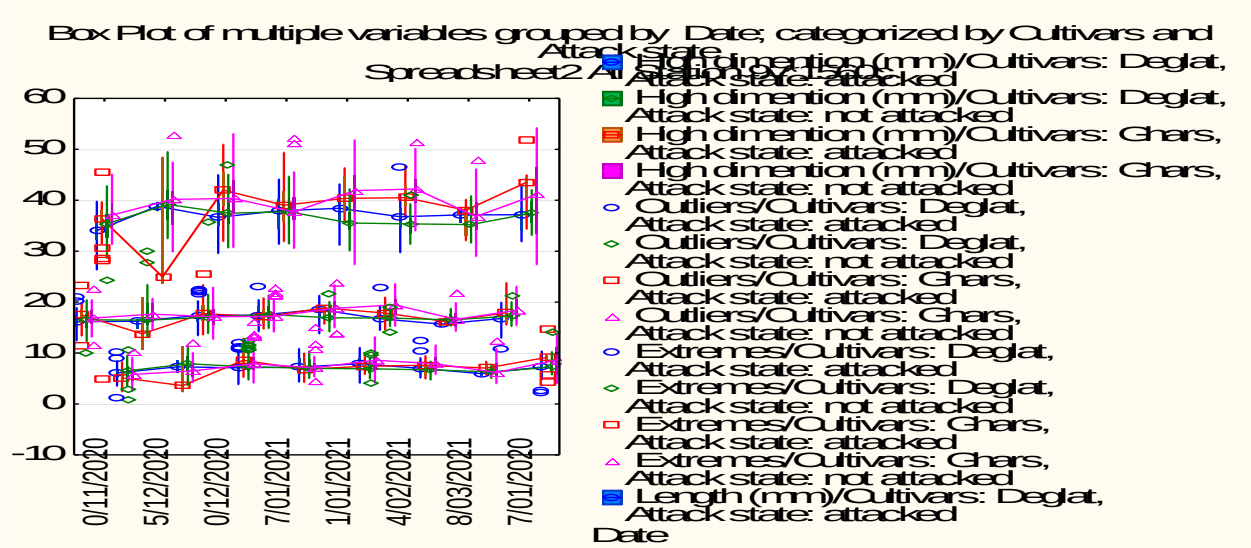


Figure 22: Box plot of attack status of the studied cultivars grouped by dates of sampling

The ANOVA test indicates that between Ghars and Deglat cultivars (attacked and not attacked), according to the sampling dates, there is a very highly significant difference ($p<0.000$), where we observe that the least attacked dates are the dates of Ghars cultivar which were sampled on December 30, 2020. On the other hand, the most attacked dates are the dates of cultivars Deglat which were sampled on February 14, 2021.

Discussion

According to Achoura et *al*, (2013), the evolution of pests is linked to different biotic and abiotic ecological factors that significantly limit their outbreak. These same authors add that the predatory activity is very marked in spring (January to March) when the ecological conditions are favorable for the development of predators, which is confirmed by our results.

3.3 Damage estimation and impact of pests on physio-chemical characteristics

Generally, physico-chemical and biochemical characteristics are an essential element to control of food products quality and to know the duration of preservation, packaging and storing (Ross, 1995). This section focuses on pest damage and its impact on the physico-chemical characteristics of stored dates.

3.3.1 Water content determination

Water content is a fundamental parameter for the determination and rational conduct of harvesting, storage or preservation operations (Meligi and Sourial, 1982). It is defined as the weight loss experienced during desiccation (Doukani and Tabak, 2014). The water content values found based on the studied cultivars are presented in table 9 and figure 23.

Table 9: Water content values of the two cultivars studied

Water content	Ghars	Deglat
Attacked dates	20,56%	15,56%
Non attacked dates	21,74%	20,50%

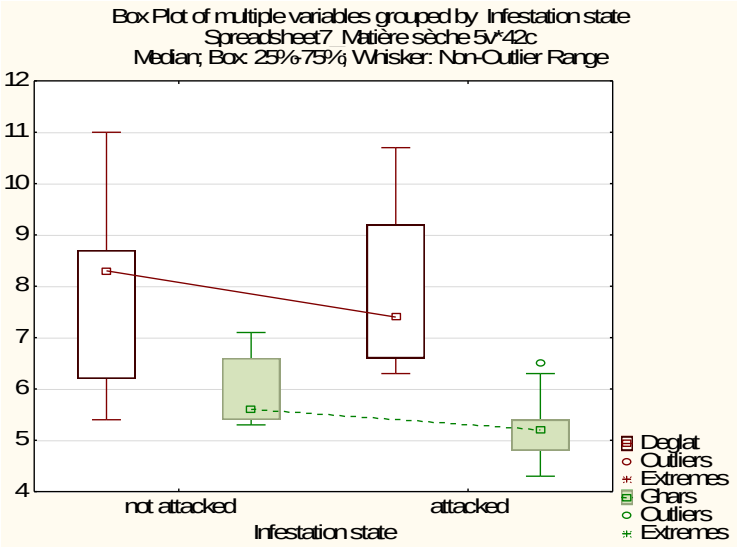


Figure 23: Box plot of water content grouped by the infestation state

The mean humidity of the attacked dates of the cultivar Ghars (20.6%) is higher than the one of Deglat (15.6%; Tab. 9). The application of the ANOVA test on the water content of the stored dates shows a non-significant difference ($p < 0.748$) between the variables according to the state of attack of dates of Deglat cultivar, on the other hand it shows a very highly significant difference for Ghars cultivar ($p < 0.000$; Fig. 23).

Discussion

Water is one of the essential constituents of the fruit. It has a fundamental importance on the quality of dates and acts on their ability of conservation (Multon, 1991; Ben Salah and Hellali, 2003). The water content of the studied cultivar Deglat is 15.6%. This result is close to the one found by Munier (1973) who mentions a value of 18%. Moreover, Giddey (1982), Gatel (1982) and Multon (1992) classify this date in the family of foods with intermediate humidity, which are easy to preserve for long periods of of storage time at room temperature.

Concerning the value found for the cultivar Ghars, it is 20.6%, relatively higher than the values of the European standards and Codex Alimentarius (2001), which is around 14%.

The obtained results are in accordance with those found by El-Naga and Abdel-Tawab (2012), who note that the water content of dates is between 19.7 and 24.4%.

The variations in humidity levels are probably due to the extraction methods, climatic conditions, storage and the type of date cultivars used (Mahtout and Saidani, 2017). On the other hand, Al-Hooti et *al*, (2002) qualified the water content by a comparative study of 2 syrups prepared from 2 cultivars (Birhi and Safri) different from those of this study with values respectively 16.8% and 16.3%.

It is worth mentioning that a water activity (aw) of a fruit < 0.9 is likely to inhibit microbial growth (Hamad, 2008). In the same context, Cheftel and Cheftel (1977) consider that the concept of water activity (aw) is essential for the stability of foods especially in terms of microbiology. However, it should be noted that there is a great variability in the water content of the date fruit to such an extent that we find varieties with water contents exceeding 60% (Nigerian varieties), requiring a stabilization treatment by drying (Falade and Abbo, 2007).

3.3.2 pH determination

pH is one of the parameters determining the ability to preserve food, it can be said that it is among the main obstacles that the microbial flora must overcome to ensure its proliferation (Giddey, 1982; Gatel, 1982). Generally, the pH of date cultivars varies according to the physiological developmental stages of the date (Dowson and Aten, 1963). The pH values found for dates of the two studied cultivars in the present study are mentioned in Table 10 and Figure 24.

Table 10: pH value of the different studied cultivars

pH	Ghars	Deglat
Attacked dates	4,9	5,6
Non attacked dates	4,96	5,23

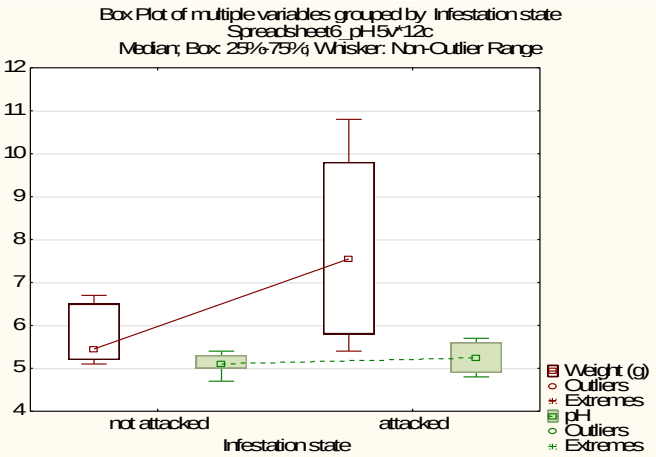


Figure 24: Box plot of the weight and pH of dates grouped by infestation state

According to these results, the dry cultivar (Deglat) has a slightly basic pH compared to the soft cultivar (Ghars). In general, the pH of the cultivar Deglat is 5.6 and Ghars is 4.9 (Table 10).

Attack status has a significant difference ($p < 0.048$) based on the weight between attacked and non-attacked dates, however there is a non-significant difference ($p < 0.450$) based on attack status.

Discussion

According to the analyses performed on common dates by Rygg (1977), a good quality date has a pH around 6, and for a bad quality, the pH is lower than 5. Meligi and Sourial (1982) and Açourene et *al* (2001), confirmed these results. The pH obtained in the present study for (Deglat = 5.6) is close to the pH obtained by Açourene and Tama, (1997) who found the pH of the same cultivar to be 5.9. Also, Mimouni (2015) reported a pH of the syrup of the same cultivar in the order of 5.

By comparing the pH of the studied dates with those of some Iraqi and Egyptian cultivars, we can say that our results are relatively inferior to those cited by Yousif et *al*, (1982), Khalil et *al*, (2002) which give values between 5.6 and 6.8. This difference can be explained by several factors such as the variety of dates used and the extraction method (Mimouni, 2009).

It should also be noted that a pH between 5 and 6 has advantages in the conservation of certain vitamins of group B such as B1, B2, B5, B9 and B12 (Bourgeois, 2003), vitamins predominant in dates.

3.3.3 Electrical conductivity Determination (EC)

The electrical conductivity expresses the ability of the aqueous solution to conduct an electric charge. The results found are listed in Table 11 and figure 25.

Table 11: Electrical conductivity values of the studied cultivars

CE	Ghars	Deglat
Attacked dates (µS)	2,63	3,1
Non attacked dates	1,63	1,43

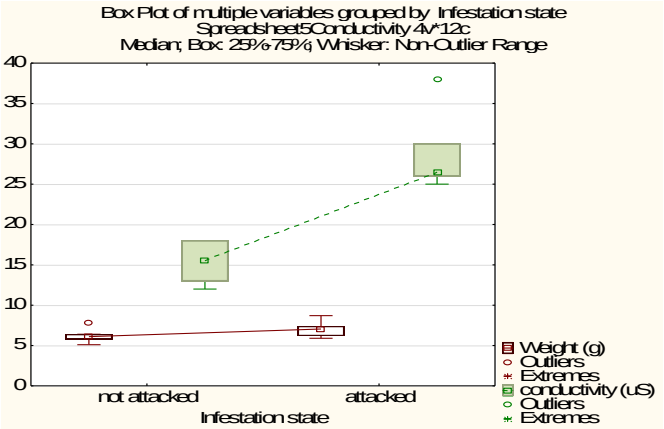


Figure 25: Box plot of weight and electrical conductivity grouped by infestation status

Table 11 shows that the electrical conductivity of the attacked dates of cultivar Ghars (EC = 2.6µS) is lower than that of cultivar Deglat (EC = 3.1µS).

According to Figure 25 which represents the weight and electrical conductivity of the studied dates Ghars and Deglat, we can distinguish a highly significant difference ($p < 0.000$), in the

weight parameter of attacked and non-attacked dates, a slight difference is observed (Fig. 25). On the other hand, a significant difference is observed between the attacked and non-attacked dates according to the electrical conductivity.

Discussion

The results found for the EC of Ghars (EC = 2.6µS) and Deglat (EC = 3.1µS) are relatively close to the results of Mimouni (2009), who said that the electrical conductivity equal to 2.69 µS/cm, 3.80 µS/cm and 3.53 µS/cm, respectively for the variety Deglet Nour, Deglat Beida and Deglat.

We could also deduce the importance of conductivity based on the color, the darker it is the more conductive the syrup is, moreover the electrical conductivity is in function of the mineral content (Gheraissa and Hamidani, 2019).

It is also related to the content of ionizable matter, of which mineral material constitutes the main part, where it depends on the nature of the dissolved ions and their concentrations (Rejsek, 2002).

3.4 Simulation test of favorable conditions for pest settlement in stock locations

This experiment is carried out in order to highlight some favorable conditions for the installation of the pests at the level of the places of stocks.

The global list of captured species in this part of the study and their numbers is presented in Table 12.

Table 12: Global list of date predator species and their numbers found in the water submersion experiment

			Ghars		**Deglat**	
Submersion time	**After (Days)**	**Species**	**IN**	**RA (%)**	**IN**	**RA (%)**
1h	15	*Ephestia kuehniella*	2	4,08	-	-
12h	-	-	-	-	-	-
24h	7	*Drosophila melanogaster*	8	16,33	-	-
		Carpophilus hemipterus	2	4,08	-	-
	15	*Drosophila melanogaster*	37	75,51	7	100
Total		3	49	100	7	100

The experiment conducted on the pests that are likely to attack the dates in storages allowed to distinguish 3 species, installed only on the cultivar Ghars. The most important species in this experiment is *Drosophila melanogaster* (91.8%), classified as a secondary pest (Tab. 12).

Discussion

This aspect is interesting in the sense that it could be taken into consideration when elaborating a program and a strategy of prophylactic treatment in the stock places. In addition, it is an indication of the phytosanitary state of the studied stockpiles. The aspect of availability, spectrum or range of attack and effectiveness of these beneficials according to their life cycles deserves to be developed, in the context of a possible biological control (Bouaicha, 2016).

Conclusion

Conclusion

The study of pests of stored dates and their predators in the region of Ouargla, and their influence on the biometric and physico-chemical parameters of these commodities in 3 places of stock at the station of Ain Beida, carried out over a period of 5 months (November 2020 until March 2021) with a frequency of 2 outings per month using two methods (hand capture and gauze fabric) on 2 cultivars (Ghars and Deglat) This survey allowed to identify 8 species of pests divided into 7 families (Tenebrionidae, Silvanidae, Dermestidae, Nitidulidae, Pyralidae, Drosophilidae and Cecidomyiidae) and 4 species of predators divided into 2 families (Braconidae and Pteromalidae).

In terms of pest species, the most important are *Apomyelois ceratoniae* (34% in Ghars; 24.1% in Deglat), *Oryzaephilus surinamensis* (12% in Ghars; 30.3% in Deglat) and *Ephestia kuehniella* (Ghars = 20.8%; Deglat = 6.2%). These are considered stock-specific pests, with a preference for the cultivar Ghars over Deglat. For predators, the most noted species on the 2 cultivars studied was *Cotesia flavipes* (Deglat= 25% and Ghars=28,8%).

In terms of biometric measurements, it is distinguished that the dates of the cultivar Ghars are of large size compared to those of cultivars Deglat. The 2nd stock contains the dates of larger size concerning the two studied cultivars (Ghars and Deglat), moreover, it is the stock most attacked by *A. ceratoniae*, *Rattus rattus* and *O. afrasiaticus* since these pests have a great preference towards the dates of large size. In addition, the longer the dates are stored, the more they are exposed to attacks by these pests.

A few physico-chemical parameters of stored dates were examined in Ghars and Deglat cultivars to demonstrate the influence of pests on the quality of attacked dates, Ghars cultivar is slightly acidic compared to Deglat cultivar. It was also determined that the water content of Ghars is higher than that of Deglat. Finally, for the electrical conductivity, it is lower for Ghars comparing with that of Deglat.

The experiment carried out on the pests that are likely to attack the dates in the places of stocks allowed to distinguish 3 species, installed exclusively on the cultivar Ghars, of which *Drosophila melanogaster* (secondary pests) is the most important found species.

In perspective, it would be interesting to extend this study on other stations by increasing the sampling effort as well as using other trapping techniques in order to capture other species. In addition, further studies on the attacks of dates in storage based on biochemical characteristics are needed considering the lack of documentation on this study. It is also

preferred if this study spreads on other cultivars for more knowledge of the possible attacks. Finally, the biomolecular use is essential for the identification of the captured species.

Bibliographical References

1. **ABERLENC-BERTOSSI F**. 2012. *La détermination du sexe du palmier dattier*. Dia de news letters. 3 : 1-8.
2. **ACHOURA A., TARAI N.** ans **BELHAMRA M.** 2013. *Influence des facteurs biotiques sur l'évolution de la cochenille blanche du palmier dattier Parlatoria blanchardi Targ., 1868 (Homoptera, Diaspididae) dans une palmeraie à Biskra.* Régions Arides. n° 35 (3/2014) : Actes du 4ème Meeting International ''Aridoculture et Cultures Oasisennes. P. 1963 – 1967.
3. **AÇOURENE S.** and **TAMA M.** 1997**.** *Caractérisation physicochimiques des principaux cultivars de datte de la région des Zibans*. Recherche Agronomique, N°1. Ed. INRAA. P : 59-66.
4. **AÇOURENE S.; TAMA M.** 2002. *Effets de quelques opérations culturales (pollinisation, limitation, ciselage et ensachage) sur le rendement et la qualité de la datte de la variété Deglet Nour de palmier dattier (Phoenix dactylifera* L.*).* Revue Recherche Agronomique, n 11, pp 27-48.
5. **AL-HOOTI S. N., SIDAV J. S., ALSAQER J. M**. and **AL-OTHMAN A**. 2002. *Chemical Composition and Quality of Date Syrup as Affected by Pectinase, Cellulose Enzyme Treatment*. Biotechnology, Department Kwait, Institute for Scientific Research Safa Kowait : 215-220.
6. **AL-HOOTI S., SIDHU J.S., QABAZARD H**. 1997. *Physiochemical characteristics of five date fruit cultivars grown in the United Arab Emirates*. Plant Food for Human Nutrition. 50:101–113.
7. **BABAHANI S.; BOUGUEDOURA N.** 2004. *Effet du ciselage combiné sur les caractères de la production dattière chez les variétés Ghars et Deglet Nour*. Revue des régions arides, I.R.A, numéro spécial, pp : 841-846.
8. **BAHLOUL W**. 2017., la Chambre algérienne de commerce et d'industrie, *31 october 2017, présentation consacrée au 3ème du Salon international de la datte de Biskra (SIDABTECH).* Alger. 2017.
9. **BELGUEDJ M**. 2002. *Les ressources génétiques du palmier dattier caractéristiques des cultivars de dattier dans les palmeraies du Sud-Est Algérien.*
10. **BEN ABDALLAH A**. 1990. *La phœniciculture*. Option méditerranéenne, n 11, pp : 105- 120.
11. **BEN SALAH M., HELLALI R**. 2003. *Phenopomologic description of 15 Tunisian cultivars of date palm (Phoenix dactyliferaL.)*. Bulletin of the Phytogenetic Resources PGRI.
12. **BENAOUDA.M/EH.** 2012**.,** *Agriculture oasienne: Situation, tendances et développement in Proceding de l'atelier sur "la sécurité alimentaire et l'agriculture Saharienne*. Université Kasdi Merbah Ouargla les 15 et 16 Février 2012. Pp 30-41.
13. **BESBES S., BLECKER C., DEROANNE C., DRIRA N.,** and **ATTIA H.** 2004. *Date seeds: chemical composition and characteristic profiles of the lipid fraction*. Food Chem. 84:577-584.
14. **BEULGEUDJ M**. 2002. *Caractérisation des cultivars de dattier dans les palmeraies du sudest Algérien*. Institut National de la Recherche Agronomique d'Algérie, Alger, 289 p.
15. **BOOIJ L., PIOMBO G., RISTERUCCI J.M., COUPE M., THOMAS D. and FURRY M.** 1992. *Etude de la composition chimique de dattes à différents stades de maturité pour la caractérisation variétable de divers cultivars de palmier dattier* (*Phoenix dactylifera* L.). Journal of fruits.Vol. 47 N.P : 667 – 677.
16. **BOUAICHA R.** 2016. *Analyse du complexe parasitaire du Grenadier Punica granatum (Linné, 1753) dans la région de Touggourt.* Mémoire du diplôme de Master en Agronomie. Ouargla : faculté des sciences naturel et de vie. 81p.
17. **BOUFIS N., KHELIFI –SLAOUI M., DJILALI Z., ZAOUI D., MORSLI A., BERNARD MA., MAKHZUM A.** and **KHELIFI L.** 2014., *Effects of growth regulators and types of culture media on somatic embryogenesis in date palm (phoenix dactylifera* L.) cv. Deglat Beida. Sci Hortic. 172:135-142.
18. **BOUGUEDOURA N., BENKHALIFA A.,** and **BENNACEUR M.** 2019. *Le palmier dattier en Algérie.* Biotechnologies du palmier dattier. P15.
19. **BOUNA Z.E.A.O.** 2002**.** *Contribution à l'étude biosystématique, ethnobotanique, biochimique, alimentaire et diététique de 11 cultivars de dattiers, Phoenix dactylifera* L., *des palmeraies de Mauritanie*. Thèse de 3ème cycle, Université Cheikh Anta Diop de Dakar. 250 p.
20. **BOURGEOIS C**. 2003. Les *vitamines dans les industries agroalimentaires.* Ed. Tech et Doc-Lavoisier, Paris, 483.

21. **BUELGUEDJ M.** 1996. *Caractéristiques des cultivars de dattiers du Sud-Est du Sahara algérien.* Vol I. Conception et réalisation : Filière « Culture pérenne » de l'ITDAS, 67p.
22. **CHEFTEL J. C.** and **CHEFTEL H.** 1977. *Introduction à la biochimie et à la technologie des aliments.* 4ème tirage. Ed. Tech et Doc-Lavoisier. Paris.367 pages.
23. **CODEX**. 2001. *Programme mixte fao/oms sur les normes alimentaires* commission du Codex Alimentarius. ALINORM 01/25, 1-31.
24. **Commissariat au Développement de l'Agriculture dans les Régions Sahariennes.** 2002.
25. **Commissariat au Développement de l'Agriculture dans les Régions Sahariennes.** 2004 **HACINI M.** and **ZATOUT M**. 2012. *Evolution de la salinité des eaux du chott de Ain El Beida (Cuvette de Ouargla).* Pp 236-243.
26. **DAKHIA N., BENSALAH M., ROMANI M., DJOUDI AM. Et BELHAMRA M.** 2013. *Etat phytosanitaire et diversite varietale du palmier dattier au bas sahara – algerie.* Journal Algérien des Régions Arides. N° Spécial 2013. 17p
27. **DAWSON R.H.W.** and **ATEN A**. 1963. Récolte et conditionnement des dattes. Organisation du Nations Unies pour l'alimentation et l'agriculture, Ed, FAO, Rome, Italie. P397.
28. **DJAFOUR S., KHABBAZE A.** and **KHOUILDI Z**. 2005. *Contribution à l'étude de la composition biochimique des dattes « Déglet–Nour ≪ dans le pédopaysage de la cuvette de Ouargla.* Mémoire de magister en Biochimie. Ouargla : Faculté de science de la nature et de vie Kasdi Merbah, 2005. 70p.
29. **DORBANE T**. 2016. *Mise en évidence des pertes dues aux rongeurs dansquelques régions sahariennes cas d'El-Meghaïer.* Mémoir de master en science agronomique. Ouargla : unniversité kasdi merbah. 73p.
30. **DOUKANI, K**. and **TABAK**, S. 2014. *Article Profil Physicochimique du fruit "Lendj" (Arbutus unedo L.)* Laboratoire d'Agro Biotechnologie et Nutrition en Zones Semi Arides Faculté des Sciences de la Nature et de la Vie, Université de Tiaret, Algérie. Journal .Nature & Technology.
31. **DOWSON H.W., ATEN A**. 1963. *Récolte et conditionnement des dattes*. Ed FAO. Rome. 398p.
32. **DOWSON V.W.H.** and **ATEN B**. 1963. *Composition et maturation, récolte et conditionnement des dattes*, collection F.A.O. Rome, p 397.
33. **DRESS F.** 2007**.** *Les probabilités et la statistique de A à Z: 500 définitions, formules et tests d'hypothèse*. Ed Paris, Dunod, 519.03 D7735p.
34. **DRESS F**. 2007. *Les probabilités et la statistique de A à Z.* Ed. Dunod. 205p.

Electronic source

35. **EL-NAGA,E.A**. and **ABD EL-TAWAB, Y. A**. 2012. *Compositional characteristics of date syrup extracted by different methods in some fermented dairy products*. Annals of Agricultural Science.57(1), 29–36.
36. **ESPIARD E**. 2002. *Introduction à la transformation industrielle des fruits*. Ed . TEC/DOC.Lavoisier. Paris. P :147-155.
37. **ESTANOV P**. 1990 . *Valorisation de la datte, in : option méditérranéenne série A* : séminaire méditérranéen N° 11. Ed cihem vol II.
38. **FAURIE C., FERRA C., MEDORI P., DEVAUX J.** and **HEMPTINNE J L**. 2003 - *Ecologie approche scientifique et pratique.* Ed. Lavoisier, Paris, 407 p.
39. **FAYADH J.M.,** and **Al-SHOWIMAN S. S**. 1990. *Chemical composition of date palm* (*Phoenix dactylifera L.*). J. Chem. Soc. Pakistan. 12: 84- 103.)
40. **FLADE K.O.** and **ABBO E.S.** 2007**.** *Air-drying and rehydration characteristics of date palm (Phoenix dactylifera L.)*. fruits. Journal of Food Engineering.Vol. 79.N. 2.724-730.
41. **GASMI D.** 2011. *Inventaire des arthropodes associés à la luzerne dans la région de Hassi Ben Abdellah,* Mem. Ing. Agro. Univ. Ouargla, 102p.
42. **GATEL**. 1982. *L'aliment à humidité intermédiaire, concept fondamentale et fiction scientifique.* APRIA .pp39-50
43. **GHERAISSA T., HAMIDANI I**. 2019. *Etude de quelques caractéristiques physico-chimiques du sirop traditionnel des dattes de deux variétés (Ghars et Tinissine)*. Mémoir Master Académique en biochimie appliquée. El Oued : Faculté des sciences de nature et de la vie, 2019. 57p.
44. **GIDDEY**., 1982. *Les produits à humidité intermédiaire. Cas particulier de problème de la conservation des produits à humidité intermédiaire*. APRIA. Pp 21-28
45. **GOURCHALA F.** 2015. *Caractérisation physicochimique, phytochimique et biochimique de cinq variétés de dattes d'Algérie, Phoenix dactylifera* L. *(Deglet noor, Ghars, H'mira, Tamesrit et*

Tinissine). Effets de leur ingestion sur certains paramètres biologiques (Glycémie, profil lipidique, index glycémique et pression artérielle). Thèse de Doctorat en biochimie.

46. **HADDOU M.** 2015. *Diagnostic sur l'effet des conditions agro-écologiques sur la qualité des dattes Deglet Nour dans la région de Ouargla.* Mémoire du Magister en Agronomie. Ouargla : faculté des sciences de la nature et de vie. 117p.
47. **HAMAD S. H**. 2008. *Microbial Spoilage of Date Rutab Collected from the Markets of AlHofuf City in the Kingdom of Saudi Arabia*. Journal of Food Protection 71, 1406- 1411.
48. **HUSSEIN F.** and **HUSSEIN M.A**. 1983. *Effect of Irrigation on Growth, Yield and Fruit Quality of Dry dates Grown at Asswan. Actes du Colloque "The First Symposium on The Date Palm"*, King.
49. **IDDER M.A., IDDER-Ighil H., SAGGOU H.** and **BERNARD P**. 2009. *Taux d'infestation et morphologie de la pyrale des dattes Ectomyelois ceratoniae (Zeller) sur diffe´rentes varie´te´ s du palmier dattier Phoenix dactylifera (L.).* V. 18. N 1. Pp 63 – 71
50. **KHALIl KE., ABD-ELBARI M.S., HAFIZ N.E.,** and **AHMED E.Y**. 2002. *Production, evaluation and utilization of date syrupconcentrate (Dibis);* In *Preparation in incorporation dans la margarine d'un extrait de date des varietiesseches.* Thèse de Magister, Université de Boumerdes.
51. **KOULL N. and HLILAT M.T.** 2015. *Effets de la matière organique sur les propriétés physiques et chimiques des sols sableux de la région d'Ouargla (Algérie).* étude et Gestion des Sols, V 23, 2016 - pp 9 – 19
52. **LEPIGRE A. L.** 1951. *Insectes du logis et du magazin. Reconnaissance. Mœurs et moyens de destruction.* Insectarium, Jardin d'Essai, Alger, 339p.
53. **LEPIGRE A. L.** 1963. *Essais de lutte sur l'arbre contre la pyrale des dattes* (*Mylois ceratoniae Zell.*, Pyralidae). « Ann. Epiphyties », 14 (2), 85/101.
54. **LINNAEUS C**. 1753. *Species plantarum, exhibentes plantas rite cognitas, ad genera relatas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas.* Vol. 2 pp. [i], 561-1200, [1-30, index], [i, err.]. Holmiae [Stockholm]: Impensis Laurentii Salvii.
55. **MADR** 2002. *Statistiques agricoles : Superficie et production.* Ministère de l'agriculture et du développement rural. Série A, pp 5-6.
56. **MAHTOUT D.** and **SAIDANI S**. 2017 . *Elaboration d'une crème glacée au sirop de dattes*. Mémoire de maste Sciences Alimentaires . Université A. MIRA - Bejaia.
57. **MELIGI M. A.** and **SOURIAL G. F. 1982**. *Fruit quality and general evaluation of some Iraqi date palm cultivars grown under conditions of barrage region*," Ed: First symposium on the date palm, Saudi-Arabia, 23-25 March. 212-220p.
58. **MESSAR.E.M.** 1996**.** *Le secteur phoenicicole algérien : situation et perspectives à l'horizon 2010. In Option méditerranéenne*. Serie A N°28. Le palmier dattier dans l'agriculture d'oasis des pays méditerranéens.. Pp: 23-44.
59. **MIMOUNI Y**. 2009. *Mise au point d'une technique d'extraction de sirops de dattes ; comparaison avec les sirops à haute teneur en fructose (HFCS) issus de l'amidonnerie*. Mémoire de Magister. Université Kasdi Marbah Ouargla.
60. **MIMOUNI Y**. 2015. *Développement de produits diététiques hypoglycémiants à base de dattes molles variété «Ghars», la plus répandue dans la cuvette de Ouargla*. Thèse de Doctorat en Sciences Biologiques, Université Kasdi Marbah Ouargla.
61. **MULTON J.L**. 1991.*Techniques d'analyses et de contrôle dans les industries agroalimentaires*. Tome II: Analyse des constituants alimentaires. Ed. Lavoisier.Paris, 450 p.
62. **MULTONJ L.** 1992. *Additifs et Auxiliaires de Fabrication dans les IAA*.Ed. Tec et Doc. Lavoisier, Paris.
63. **MUNIER P**. 1973. *Le palmier dattier*. Paris, Maisonneuve et Larose, 221 p.
64. **NOBLECOURT T., SOLDATI F.** and **BARNOUIN T.** 2012**.** Echan*tillonnage des coléoptères aproxyliques dans la Réserve Naturelle des Gorges du Gardon (France, Hérault)* - Echantillonnage 2012, Quillan : Office National des Forêts, Laboratoire National d'Entomologie Forestière, 27 p.
65. **NOUI Y**. 2007. *Caractérisation physico-chimique comparative des deux principaux tissus constitutifs de la pulpe de datte Mech-Degla.* Mémoire de magister en Technologie alimentaire. Boumerdes : faculté M'hamed Bougara,2007. 62p
66. **OMARI** C., 2019. Le Salon national des produits agricole de terroir, *02 december 2019, Datte : une production de 12 millions de quintaux en 2019.* Alger. 2019.

67. **PEYRON G**. 2000. *Cultiver le palmier dattier.* Ed. Cirad. Vol. 19. 110 pages.
68. **POPENOE W**. 1938. *Manual of tropical and subtropical fruits*. New-York, The Macmillan Company, 544 p.
69. **REJSEK F**. 2002. *Analyse des eaux, aspects réglementaires et techniques*. Ed. Dunod, Paris.
70. **REYNES M., BOUABIDI H PIOMBO G.** and **RISTERUCCI A.M.** 1994. *Caractérisation des principales variétés de dattes cultivées dans la région du Djérid en Tunisie. Fruit, (49), (4),* 289-298.
71. **ROSS D.A**. 1995. *Introduction to Oceanography*. New York, NY: HarperCollins. pp. 236-242.
72. **ROUVILLOIS-BRIGOL M.** 1975. *Le pays de Ouargla*. Variations et organisation d'un espace rural en milieu désertique. Thèse de Doctorat, Univ. Paris-Sorbonne, France, 389 Pp.
73. **RYGG G**. 1977. *Date development Hanging and Paching in the united state Agriculture*. Res ser Agric. Hand book (482).US Washington D.C. 28-29.
74. **SAYAH Z.** and **OULD EL HADJ M.D**. 2010. *Étude comparative des caractéristiques physico-chimiques et biochimiques des dattes de la cuvette de Ouargla*. Annales des Sciences et Technologie, 2(1), pp : 87-92.
75. **TIDJANI M.S**. 2005. *Valorisation des dattes communes et des rebuts des dattes par la production du vinaigre*. Mémoire d'ingénieur. INATAA.Université de Constantine. 53 pages.
76. **TIRICHINE H S**. 2010. *Etude ethnobotanique, activité antioxydants et analyse photochimique de quelques cultivars de palmier dattier (phoenixdactylifera L.) du sud- Est Algérien*. Mémoire du diplôme de Magister en Biologie. *Université d'ORAN- Es Senia.* 106.
77. **VANDERCOOK C.E., HASEGAWA S.,** and **MAIER V.P**. 1977. *Quality and nutritive value of dates as influenced by their chemical composition*. Date Grow. Inst. Rep. 54: 3-11.
78. **YOUSIF A.K., BENJAMIN N.D., IDIN S.M.A** and **ALI S.M**. 1976. *Nutritive value of commercial Iraqi date cultivars*. Palm & Date Res. Cent., Tech. Bull. 7, Baghdad, Iraq.
79. **YOUSSIF A.K., BENDJAMINE N-D., KADO A., ALDIN S.M** and **ALIS M.** 1982. *Chemical copposition of four Iraq date cutlivars, in « Préparation et incorporation dans la margarine d'un extrait de dattes des varietiesseches »*. Thèse de Magister, Université de Boumerdes.
80. **ZEDDOUR H**. 2011. *Marketing de la datte en Algérie. Cas de quelques Wilaya*. Mémoire de Magister-année universitaire. 264p.

(1) https://www.statcan.gc.ca/edu/power-pouvoir/ch13/prob/5214895-fra.htm

Etat et qualité phytosanitaire des dattes en stock dans la région de Ouargla

Résumé

L'étude biométrique et physico-chimique des dattes en stock dans les trois lieux de stocks à Ouargla est réalisée durant 5 mois (Novembre jusqu'au Mars) sur deux cultivars Ghars et Deglat, afin de déterminer les causes des attaques et leur influence sur la qualité et les propriétés des dattes stockées. Ce travail nous a permis de recenser 12 espèces arthropodes, dont 4 sont des prédateurs et 8 déprédateurs. Ces derniers sont représentés le plus par *Apomylois ceratoniae* (34%) et *Ephestia kuehniella* (20,8%). Alors que les prédateurs sont notés le plus par *Cotesia flavipes* (28,8%). Le cultivar Deglat est légèrement acide (pH =5,6) par rapport au Ghars (pH =4,9), par contre il est inférieur en teneur en eau (15,6%) à celle du Ghars (20,6%) avec une conductivité électrique égale à 3,1µS et 2,6µS respectivement. L'étude réalisée sur les déprédateurs susceptibles d'attaquer les dattes dans les lieux de stocks a permis de distinguer 3 espèces, à savoir *Drosophila melanogaster*, *Carpophilus hemipterus* et *Ephestia kuehniella.*

Mot clés : Stock, dattes, ravageurs, biométrie, physico-chimie, Ouargla.

State and phytosanitary quality of dates in stock in the region of Ouargla

Abstract

The biometric and physico-chemical study of the dates in stock in the three locations in Ouargla is carried out during 5 months (November to March) on two cultivars Ghars and Deglat, in order to determine the causes of the attacks and their influence on the quality and properties of the stored dates. This work has allowed us to identify 12 arthropod species, of which 4 are predators and 8 pests. The laters are represented most by *Apomylois ceratoniae* (34%) and *Ephestia kuehniella* (20.8%). While predators are noted most by *Cotesia flavipes* (28.8%). The cultivar Deglat is slightly acidic (pH =5.6) compared to Ghars (pH =4.9), however it is lower in water content (15.6%) than Ghars (20.6%) with an electrical conductivity equal to 3.1µS and 2.6µS respectively. The study conducted on the pests that are likely to attack the dates in the stock locations has distinguished 3 species, namely *Drosophila melanogaster*, *Carpophilus hemipterus* and *Ephestia kuehniella*.

Key words: Stock, Dates, Pests, Biometry, Physico-chemical, Ouargla.

الجودة والصحة النباتية للتمور المتوفرة في منطقة ورقلة

ملخص

تم إجراء الدراسة البيومترية والفيزيوكيميائية للتمور المخزنة في ثلاثة مواقع بورقلة خلال 5 أشهر (من شهر نوفمبر الى غاية مارس) على صنفين غرس ودقلة، من أجل تحديد أسباب الهجومات وتأثيرها على جودة وخصائص التمور المخزنة. سمح لنا هذا العمل بتحديد 12 نوعًا من المفصليات، 4 منها نفعية و8 آفات. تتمثل هذه الاخيرة في (34%) *Apomylois ceratoniae* و*Ephestia kuehniella* (20.8%) بينما يلاحظ معظم الحشرات النافعة تتمثل في .*Cotesia flavipes* (28.8%). الصنف دقلة حمضي (pH=5,6) مقارنة مع صنف الغرس.(pH=4,9) غير أنه أقل منه في المحتوى المائي حيث انه يحتوي على نسبة 15.6% بينما يحتوي الغرس على نسبة 20.6% مع ناقلية كهربائية تساوي µS3.1 و µS2.6 على التوالي. الدراسة المطبقة على الآفات المرجحة لمهاجمة التمور المخزنة سمحت لنا بتمييز 3 أنواع من الحشرات هي *Drosophila melanogaster*, *Carpophilus hemipterus* و *Ephestia kuehniella*.

كلمات مفتاحية: مخزون، تمر، آفات، بيومترية، فيزيوكيميائية، ورقلة.