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## Current state of 'Majhoul' date palm in the Tinejdad region, Tafilalet area, Morocco

Mohamed ARBA<sup>1,\*</sup> Atmane ELLADI<sup>2</sup> and Hicham OUACHOUO<sup>3</sup>

<sup>1</sup> Former Professor at Hassan II Institute of Agronomy and Veterinary Medicine, Horticultural Complex of Agadir, BP 121, Ait Melloul 15086, Morocco.

<sup>2</sup> National Agency for the Development of the Oases and Argan Zones (ANDZOA), Department of the development of the oase zones. Route Rissani, Erfoud PK 7 RASZ, Morocco.

<sup>3</sup> Agricultural Materials Company (AGRIMATCO), Department of the development and management of agricultural products. 27 Boulevard Zerktouni, 20100 Casablanca, Morocco.

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### Abstract

This research work was carried out on about twenty farms of different sizes where 'Majhoul' date palm is cultivated in the various oases extensions in the Tinejdad region, Tafilalet area. It focused on the cultivation practices of this variety, mainly fruit thinning which is crucial in the production of 'Majhoul' date palm and concerned about farmers because of its high cost as it requires skilled labor. And this in order to study the impact of this manual thinning on the production costs of 'Majhoul' date palm in the region and to make an alternative to this manual practice which is expensive, by using another method, mainly chemical thinning which is not expensive. Obtained results showed that 60% of the surveyed farmers practiced manual fruit thinning and that the cost of this operation seems to be expensive for the farmers. It costs 20 MAD per palm tree in large farms (containing more than 300 palm trees), 10 MAD per palm tree in the medium farms (100-300 palm trees) and 6 MAD per palm tree in the small farms (less than 100 palm trees). This cost represents 14 to 15% of the production costs of large and medium-sized farms of 'Majhoul' date palm in the region.

**Keywords:** Majhoul date palm; Tinejdad region; Tafilalet area; Cultivation practice; Fruit thinning

### 1. Introduction

Date palm is grown worldwide in Africa, North and South America, Asia and the Middle East and North African countries provide about 90% of the total production [1, 2]. The current worldwide production is about 9 million tons, with Egypt occupying the 1<sup>st</sup> place with 1.5 million tons and Iran the 2<sup>nd</sup> place with 1.2 million tons [3]. In Morocco, the current production of dates is over 102,000 tons and the area occupied by date palm is for more than 60,000 ha. The south-eastern region of Draa-Tafilalet is the main production area in the country [4]. The varietal diversity is rich and varied, and consists of more than 453 varieties where some of them are considered as commercial varieties, mainly 'Majhoul', 'Bouffegous', 'Bouskri', 'Nejda', 'Jihel', ... varieties [4]. The cultivation of date palm in Morocco has recently seen an important development in the oases extensions thanks to the planting programs which are carried out in the framework of the Moroccan green plan project and the agricultural development programs carried out by the regional offices of agricultural development (ORMVA) of Draa and Tafilalet areas.

In the Tinejdad region, several farms are converted to the cultivation of 'Majhoul' date palm which is the first choice commercial variety thanks to its fleshy large size and good quality dates. The cultivation practices of 'Majhoul' date palm are not well known in the Tinejdad region, so that we proposed to analyze the situation of the cultivation of this variety in the region, mainly the cultivation practices which are crucial in the yield crop and date quality, such as watering, fertilizing, pollination and fruit thinning. This latter practice is a manual operation which is expensive for the farmers

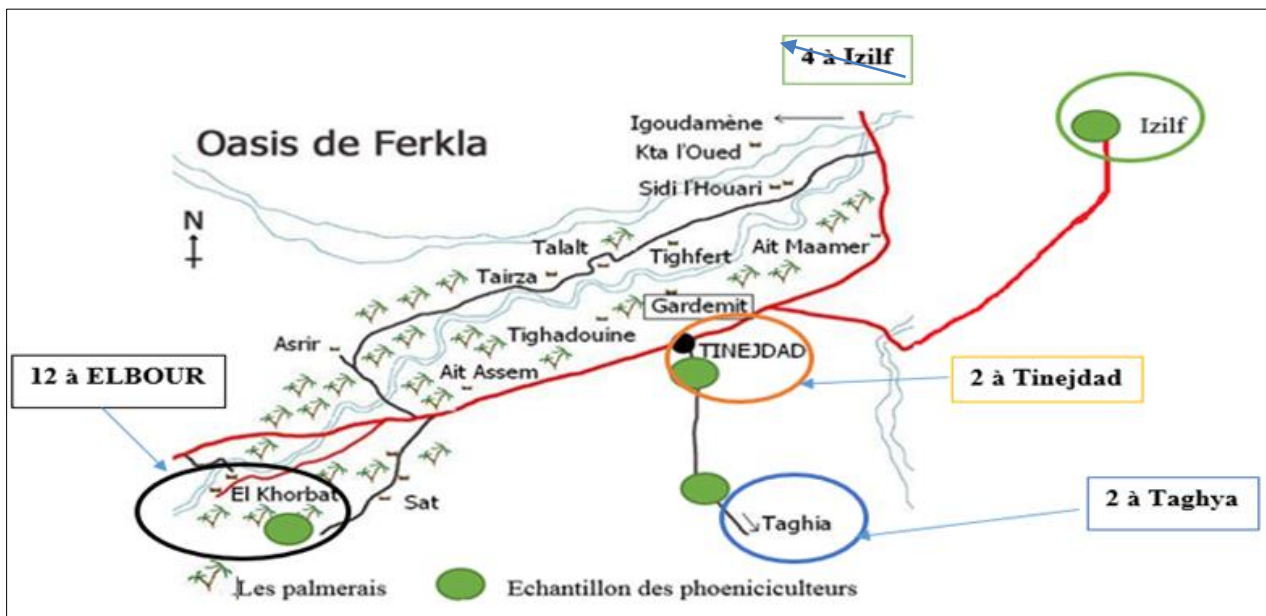
\* Corresponding author: Mohamed ARBA

because it requires skilled labor. In order to obtain information on the cultivation of 'Majhoul' date palm in the Tinejddad region, we conducted a field survey among farmers who are growing this variety to collect information on the cultivation practices which are crucial for the improvement of the yield and date quality of this variety. Our work aims to promote the cultivation of 'Majhoul' date palm in the region by conducting a survey on the cultivation practices which are crucial in the production of this variety, mainly fruit thinning which is a manual practice currently concerned about the farmers because it is expensive. Our study also aims to provide an alternative to this manual operation by proposing other practices, which are not expensive, such as chemical thinning using synthetic products like as NAA (Naphthalene acetic acid). Thus, we conducted a survey on the cultivation practices of 'Majhoul' date palm among farmers who are growing this variety in the region. Three categories of farms were considered in this study: small, medium and large farms in different sites of the oases extensions in the Tinejddad region.

## 2. Material and methods

### 2.1. The sampling of farms and farmers for the survey

To achieve this research work, contacts with resource persons who are in relation with the subject of study were taken in order to collect information and data which are crucial for the conduct of the survey and the identification of the sites where 'Majhoul' date palm is cultivated in the region. Moreover, the limitation of the cultivation practices which are decisive in the production of this variety in the region. Then we have proceeded to the sampling of farms and farmers that will be considered in the conduct of the survey. The sample of farmers consists of 20 farmers randomly selected from a population of 87 farmers who are growing 'Majhoul' date palm in the Tinejddad region (Figure 1). It is divided into three categories of farmers based on the size of their farms or the number of palm tree per farm, and these farms are distributed across all the 'Majhoul' growing sites in the oases extensions of the Tinejddad region. The classification of farms according to their size resulted in three categories of farm: small farms with 1-100 palm trees, medium farms with 101-300 palm trees and large farms with more than 300 palm trees. The number of surveyed farms per category of farm and the percentage of each category of farm in the Tinejddad region are shown in Table 1.



**Figure 1** Geographical localization of the studied oases extensions in the Tinejddad region, Tafilalet area, and the number of surveyed farms of 'Majhoul' date palm in each oasis extension: 4 farms in Izilf oasis extension, 2 in Tinejddad oasis extension, 12 in Elbour oasis extension and 2 in Taghia oasis extension

**Table 1** Number of surveyed farms of ‘Majhoul’ date palm per category of farm (small, medium and large farm) and the percentage of farms of each category of farm in the total farms of ‘Majhoul’ date palm in the Tinejdad region, Tafilalet area.

Category of farm	Number of farms by category of farm	Percentage of farms in the total farms in the region
Small farms	5	25
Medium farms	4	20
Large farms	11	55
Total	20	100

## 2.2. Elaboration of the survey form

After the selection of the sample of the survey, we developed a survey form that we considered essential to carry out the survey and to collect a maximum of information in order to obtain reliable and usable results for the profession. The survey form developed is as follow:

- What is the varietal profile of your farm?
- What is the yield of production?
  - In kg/palm tree or tons/ha
- Do you practice the reduction of clusters?
  - If yes:
    - How many clusters kept per palm tree?
    - The kept clusters are from which flowering phase?
    - What is the cost of this practice?
- Do you practice the chiseling of clusters?
  - If yes:
    - How many spikelet are removed per cluster?
    - What kind of spikelet are removed?
    - What is the cost of this practice and its part in the total cost of production?
- Other cultivation practices carried out:
  - - Working the ground: mechanical? Manual? The cost?
  - - Weed control: Manual? Mechanical? Chemical? The cost?
  - How do you pollinate?
  - - Watering: Traditional? Localized? The cost?
  - - Fertilizing: Organic? Mineral? Other? The cost?
  - If other? How?
  - - Do you practice the cleaning of palm trees? The cost?
  - - Do you protect the clusters against insects and birds? The cost?
  - - How are you making fruit harvesting? The cost?
  - Do you practice the packaging design?
  - The storage of dates?
  - The cost?
  - How are you selling your production? Direct to Customer? To intermediates?
  - The selling price?

## 2.3. The conduct of the survey

After the sampling of the farmers and farms to be surveyed and developing the survey form, we proceeded to the conduct of the survey in the field. The survey focused on the cultivation practices which are crucial for the improvement of fruit yield and quality of ‘Majhoul’ date palm, including planting density, pollination, limitation of clusters, fruit thinning, watering, fertilizing, harvesting, ...

## 2.4. Data processing

Data processing started with the input of data into Excel software in order to establish a database. Quantitative data are directly reproduced and qualitative data are codified in order to constitute classes of data which may be easily processed and analyzed.

## 3. Results and discussion

Our investigation on the cultivation practices of 'Majhoul' date palm in the Tinejdad region resulted in some cultivation practices which are crucial in the production of this variety in the region.

### 3.1. Planting density

Obtained results from our survey showed that the planting density of 80% of surveyed farms is ranging from 122 to 200 palm tree per ha and that of 20% of surveyed farms is more than 200 palms per ha. This indicates that with the exception of some farms where the planting density is for 122 palm tree per ha, most surveyed farms are not in the recommended range for the planting density of 'Majhoul' date palm (100-121 palm tree per ha) [5]. Probably because the size of the most farms in the region is small. High planting density affect negatively the cultivation of date palm by causing the lack of light and air circulation indoor the plantation, creating a microclimate which is favorable for the development of fungal diseases (inflorescences rotting) and pest diseases (white cochineal on the palm leaves).

### 3.2. Pollination

Date palm is a dioecious species where pollination is crucial in the yield and date quality [6, 7, 8, 9]. Our results showed that all surveyed farmers use traditional pollination by placing some spikelet (1 to 3) of the male inflorescence in the center of the female inflorescence. 45% of surveyed farmers are placing 2 spikelet of male inflorescence in each female inflorescence, 40% of them are placing 3 spikelet per female inflorescence and the rest of farmers (15%) are placing only 1 spikelet per female inflorescence (Table 2).

**Table 2** Pollination period of 'Majhoul' date palm in the Tinejdad region, and the time of its application during the day.

Category of farm	Number of surveyed farms par category of farm	Number of male spikelet placed in the female inflorescence	Pollination period	The time when pollination is practiced during the day
Small farms	1	3	After the opening of all the spathes	In the middle day
	2	2	After the opening of all the spathes	In the middle day
	3	3	2 to 3 days after the opening of spathes	In the morning after sun set
	4	2	2 to 3 days after the opening of spathes	In the morning after sun set
	5	2	2 to 3 days after the opening of spathes	In the morning after sun set
Medium farms	6	2	2 to 3 days after the opening of spathes	Not precized
	7	2	2 to 3 days after the opening of spathes	In the morning after sun set
	8	2	2 to 3 days after the opening of spathes	Not precized
	9	2	2 to 3 days after the opening of spathes	In the morning after sun set

Large farms	10	1	2 to 3 days after the opening of spathes	In the morning after sun set
	11	2	2 to 3 days after the opening of spathes	In the morning after sun set
	12	1	After the opening of all the spathes	In the middle day
	13	1	After the opening of all the spathes	In the middle day
	14	3	15 days after the opening of spathes	In the morning after sun set
	15	3	15 days after the opening of spathes	In the middle day
	16	2	15 days after the opening of spathes	In the middle day
	17	3	15 days after the opening of spathes	In the middle day
	18	3	15 days after the opening of spathes	In the middle day
	19	3	15 days after the opening of spathes	In the middle day
	20	3	15 days after the opening of spathes	In the middle day

Table 2 shows that the majority of surveyed farms (more than 50%) are of large size pollinated 15 days after the opening of the spathes or after the opening of all the spathes. While the rest of the surveyed farms are pollinated 3 to 4 days after the opening of the spathes. Most farmers of the surveyed farms practiced the pollination in the morning after sun set or in the middle of day. Several authors reported that the pollination and flowering periods of the pollinator and the variety to be pollinated must overlap [8, 10]. Other authors indicated that the best time to practice pollination is between 10 am and 15 am during the day, when temperatures are favorable for pollination [11] and the duration of the flower receptivity in 'Majhoul' date palm is 9 to 12 days after the opening of the spathes [5].

### 3.3. Limitation of the clusters

The thinning practice is a decisive operation in the quality of dates and two types of thinning are practiced on 'Majhoul' date palm in the region. The limitation of clusters or the reduction of the number of clusters per palm tree, and fruit thinning or the reduction of the number of fruits per cluster [5, 12, 13]. The aim of these practices is to achieve a balance between the yield and the quality of dates and to avoid the phenomenon of alternating production. Keeping a high number of clusters per palm tree resulted in high yield, small size and low quality of dates and an alternation of production. Thus, it is advisable to practice the limitation of clusters when the number of clusters per palm tree is high. Most of surveyed farmers (80%) practiced the reduction of clusters and kept only the clusters of the seasonal flowering, and the practice period differs from one farm to another, according to its size and the period of pollination. They often kept 6 to 7 clusters per palm tree and sometimes 5 or 8, depending on the age of the palm tree, the number of palms per palm tree and the fruit load of the clusters. The percentage of farms where the number of clusters is reduced to 7 is 50%, that of farms where the number of clusters is reduced to 6 is 31.25%, the number of farms where the number of clusters is reduced to 5 is 12.5% and that of farms where the number of clusters is reduced to 8 is only 6.25% (Table 3). Several authors reported that the limitation of clusters is based on the age of palm tree and watering and mineral nutrition of the plant, and must be within the standard of 1 cluster per 8 to 10 palms [5, 14]. The number of clusters kept per palm tree in the surveyed farms seems to be low compared to the recommended standards, probably because of the low number of palms per palm tree that did not allow to keep more than the farmers have kept in their palms, and also because of the watering and mineral nutrition of plants which seems to be insufficient.

**Table 3** Practice of the operation of the limitation of clusters on 'Majhoul' date palm and the number of clusters kept per palm tree in the Tinejdad region, Tafilalet area

Category of farm	Number of surveyed farms per category of farm		Number of farms where the reduction of clusters is practiced		Number of clusters kept per palm tree
	Number	%	Number	%	
Small farm	5	20	5	100	6 to 7
Medium farm	4	25	1	25	No limitation of clusters
Large farm	11	55	10	90,09	6 to7
Total	20	100	16	80	

### 3.4. Fruit thinning

Fruit thinning may be achieved by reducing the number of fruits or spikelet per cluster and/or the length of spikelet [5, 12, 13, 15]. Fruit thinning aims to improve the yield and date quality and also to aerate the clusters and to avoid a very staggered ripening dates. About 60% of the surveyed farmers practice the chiseling of clusters or fruit thinning and the rest of the farmers (40%) do not practice nor the chiseling of clusters nor fruit thinning (Table 4). In the category of farmers who practice the chiseling of clusters or fruit thinning, 58% of them practice only the chiseling of clusters by removing 1/4 of the spikelet in the center of the clusters. Whereas 42% of farmers practice only fruit thinning and the number of removed fruits is usually between 6 and 7 per spikelet.

**Table 4** Practice of the operations of chiseling of clusters and fruit thinning on 'Majhoul' date palm in the Tinejdad region, Tafilalet area

Category of farm	Number of surveyed farms per category of farm		Farms where the chiseling of clusters or fruit thinning are practiced		Farms where nor cluster chiseling nor fruit thinning are practiced	
	Number	%	Number	%	Number	%
Small farm	5	25	4	80	1	20
Medium farm	4	20	2	50	2	50
Large farm	11	55	6	54,54	5	45,45
Total	20	100	12	60	8	40

Fruit thinning consists of reducing the number of spikelet per cluster or the number of fruits per cluster on loaded clusters when the fruits are still small [16]. It is an expensive manual practice because it requires skilled labor, thus, it leads to high production cost for the farmers, especially those with large farms. Hence the need for a low-cost practice, such as chemical thinning using synthetic products like as NAA (Naphthalene acetic acid). This chemical thinning practice is at the origin of this survey study in order to collect information on fruit thinning practices used in 'Majhoul' date palm and on other cultivation practices, which are important for this variety in the region and the production costs of these practices. This is in order to study the effect of the chemical practice on the fruit thinning of 'Majhoul' date palm and to compare the cost of this chemical thinning operation with that of the manual thinning in the production cost of 'Majhoul' date palm in the Tinejdad region. Our study also aims to introduce this new chemical thinning practice in the region and to use it instead of the manual thinning. Thus, this will reduce the production costs for the farmers by reducing the fruit thinning costs. Moreover, thanks to this study, research experiments were carried out on the chemical thinning of 'Majhoul' date palm using different concentrations of NAA after pollination.

### 3.5. Fruit harvesting

Fruit harvesting is carried out manually and 80% of the production is sold on the ground to intermediates who will make themselves the harvesting and the marketing of the purchased production. While 20% of the production is sold directly by small farmers to their customers. Regarding the yield of production, it is different between farms in the

region, depending on their size, the cultivation practices used and the set objectives (Table 5). The storage of 'Majhoul' dates in the refrigeration stations is done only by 45% of the surveyed farmers.

**Table 5** Fruit yield of 'Majhoul' date palm according to category of farm in the Tinejdad region, Tafilalet area

Category of farm	Number of surveyed farms per category of farm		Fruit yield of 30-50 kg/palm tree		Fruit yield of 51-70 kg/palm tree		Fruit yield of 71-90 kg/palm tree	
	Number	%	Number	%	Number	%	Number	%
Small farm	5	25	2	40	2	40	1	20
Medium farm	4	20	2	50	2	50	0	0
Large farm	11	55	1	9,09	10	90,91	0	0
Total	20	100	5	25	14	70	1	5

Generally the mean yield of an adult 'Majhoul' date palm is about 70 kg per palm tree. The crop is sold by the farmer to the intermediates at a price of 50 to 80 MAD per kg, or 3,500 to 5,600 MAD per palm tree, depending on the date quality. This shows that the selling price of a 'Majhoul' date palm tree in the study area is attractive and its profitability may be sufficient for the farmers. In the retail markets, 'Majhoul' dates are sold to consumers at a price ranging from 50 to 150 MAD per kg, depending on the date quality.

### 3.6. Production cost of the three categories of farm

For purely economic reasons, we were able to obtain from the surveyed farmers data on the production cost of 'Majhoul' date palm in the region (in MAD per palm tree). The objective of this investigation is to clarify the cost of the manual thinning practice which is a subject concerned about the farmers in the region because of its expensive cost. The cost of the manual thinning of 'Majhoul' date palm in the study area represents 15% of the production cost in large farms, 14% of the production cost in medium farms and 9% of the production cost in small farms. To allow us to compare the production cost of the three categories of farm (small, medium and large farm), the production cost of the other cultivation practices are shown in Table 6. The time required for a skilled worker to practice the manual thinning of one palm tree with 8 clusters and an average height of 2-3 m is two hours (15 minutes per cluster). This shows the need to look for an alternative practice which is less expensive and do not require skilled labor to perform fruit thinning, mainly chemical thinning using synthetic products such as NAA.

**Table 6** Production cost of 'Majhoul' date palm according to the category of farm (small, medium and large) in the Tinejdad region, Tafilalet area

Cultivation practice	Category of farm					
	Small farm		Medium farm		Large farm	
	Production cost (MAD/palm tree/year)	%	Production cost (MAD/palm tree/year)	%	Production cost (MAD/palm tree/year)	%
Ground working	2.30 ± 0.39	3.33	3.13 ± 0.84	4.30	3.73 ± 0.68	2.80
Watering and Fertilizing	32.00 ± 5.00	46.28	50.00 ± 10.59	68.72	96.45 ± 10.22	72.53
Pollination	7.50 ± 0.44	10.85	7.63 ± 1.09	10.49	10.50 ± 0.62	7.90
Cluster limitation	2.60 ± 0.48	3.76	2.00 ± 0.00	2.75	2.80 ± 0.49	2.11
Fruit thinning	6.00 ± 1.39	8.68	10.00 ± 0.00	13.74	19.50 ± 2.47	14.66
Fruit harvesting	18.75 ± 2.45	4.64	0.00 ± 0.00	0.00	0.00 ± 0.00	0.00
Total	69.15	100	72.76	100	132.98	100

Table 6 shows that watering and fertilizing are the most expensive cultivation practices for all the category of surveyed farms. The cost of fruit thinning is different between the three categories of farm. This practice is carried out by skilled labor only in the large and medium farms, whereas in small farms it is carried out by the farmers themselves. This explains its expensive cost in the large-sized farms.

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#### 4. Conclusion

This research work allowed us to identify several findings on the cultivation practices of ‘Majhoul’ date palm in the region, mainly the lack of information on the cultivation operations which are crucial in the production of this variety, as watering, fertilizing and pollination, and the difficulties associated with certain cultivation practices such as fruit thinning which is a decisive practice in the success of the cultivation of ‘Majhoul’ date palm in the region. Therefore, this manual practice is expensive for the farmers because it requires skilled labor. Our results have shown the problematic which is related to the financial and practical aspects of the thinning operation. They have also demonstrated the need to replace this expensive operation by another practice which is less costly and not requiring skilled labor, such as chemical thinning using synthetic products like as NAA. Moreover, in this way, our investigative work has led to some research experiments which have been carried out on the chemical thinning of ‘Majhoul’ date palm using NAA in the Tinejdad region, Tafilalet area.

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#### Compliance with ethical standards

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##### *Disclosure of conflict of interest*

The authors declare no conflict of interest.

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