

# Effect of Cultural Practices on the Growth of Date Palm VitroPlants Planted in Errachidia (South East of Morocco)

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**Abstract:** *In vitro* multiplication of date palm is a very promising way for the rehabilitation of Moroccan palm devastated. The objective of this work was to study the development of vitroplants introduced into traditional and modern palm of the Errachidia region. The procedure followed is to make descriptive diagnoses in different sites where the palm was introduced and to evaluate the mortality of plants and cultural practices. The mortality rates varied from 78% to 19% in new plantation depending on the cultivation technique used. At the traditional palm, the rate of recovery of plantlets was zero. The mortality is higher in Nejda cultivar compared to Boufegouss. This variety also presented a better adaptation in terms of shoot height in comparison with the development of Nejda and Mejhoul varieties. The production of offshoots as well as inflorescences takes place three years after plantation. The importance of improving cultivation techniques in date palm for the development of this sector in Morocco is discussed.

**Key words:** Date palm, cultural practices, vitroplants, *Phoenix dactylifera*.

## 1. Introduction

The use of *in vitro* multiplication of date palm is a very promising way for the rehabilitation of Moroccan palm devastated [1-2].

The main problems of date palm sector in Morocco are drought and mismanagement of water; non-sector modernization and abandonment to other cultures and income-generating activities; disease bayoud and sand encroachment [3-6].

To promote date palm, the Ministry of Agriculture has identified two fields to develop this sector: (i) the

expansion of date palm area by planting 2.9 million trees of resistant varieties to Bayoud disease in 2020; (ii) the increasing of date production to reach 185,000 tons by 2030 and improve its quality and marketing.

Plant tissue culture, especially organogenesis, has been used in Morocco to produce and make available a large number of normal and disease-free plants to farmers in order to renovate the old palm and/or to establish new orchards [7-9]. The researchers study the agronomic behavior and the true-to-typeness of vitroplants in different experimental stations before their distribution to date palm growers. However, satisfying the national demand of date palm vitroplants does not only mean deliver plants to

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farmers in sufficient number, but also ensure their recovery rates and production dates as well. Under modern plantation in Tafilalet region, the biggest producers of dates succeed the vitroplants cultivation with a strong recovery rate, but what about the small farmers? Currently, there is no published work relating to the becoming of vitroplants planted in Moroccan palm. Technical factor contributing to success of date palm cultivation has been discussed in many symposia and publications [10-13]. However, a lack of transfer and adoption of suitable technologies developed regionally was observed.

The aims of this work were first to study the behavior of plantlets introduced into traditional and modern palm and second to determine the effects of technical practices on the success of vitroplants recovery.

## **2. Methodology**

### *2.1 Study Sites*

The study was conducted in the region of Errachidia at south-east of Morocco (1,034 m; 31°55.8' N, 5°36.0' E). This region is characterized by long dry summers and cold winters (arid climate). The temperature averages are -1.5 °C (January) and +50 °C (July) and the annual precipitation does not exceed 100 mm.

This study was focused on the execution of descriptive diagnoses with regard to farmers. It concerned the following parameters: time of planting vitroplants, planting depth, plant protection and shelter belts, irrigation system and soil improvement and fertilization.

Five sites were considered during this preliminary study to determine the behavior of vitroplants distributed to farmers (Table 1).

### *2.2 Parameters Studied*

The mortality of plants depending on the cultivation technique was evaluated in the five sites cited above. Monitoring of plant growth parameters (shoot height)

and their production times was also performed.

### *2.3 Statistical Analysis*

The data were analyzed with ANOVA using SPSS Statistic 16.0, the significance of differences among treatments was recorded at  $p < 0.05$  by Post-hoc comparisons using SNK (Student-Newman-Keuls) test.

## **3. Results**

### *3.1 Description of Prospected Sites*

Five sites were visited during this preliminary study. The results of our diagnosis are summarized in Table 1. They show difference in practical cultures used by farmers depending on localization of sites. Those located in the extensions are characterized by a mastery of these techniques. However, we have observed deficiencies especially in the methods of irrigation, planting and plant protection (Figs. 1 and 2).

### *3.2 Parameters Studied*

The comparison of mortality rates at different sites and therefore according to the degree of technicality shows a significant difference between localities (F: 2,238,774;  $p < 0.0001$ ). These rates varied from 19% to 24% in modern palm where cultivation techniques were mastered such as drip irrigation (pumping station), fertigation, installation of shelter belts, the size of the plants and weeding. However, the installation of the irrigation system localized (drip) is not sufficient to ensure a good recovery of plantlets. In fact, the mortality rate reached 78% at the site where this technique is not accompanied by other cultivation techniques mentioned above and it did not exceed 26% at the site where there was irrigation gravity but mastered providing adequate irrigation for the resumption of plantlets. In the traditional palm, the rate of recovery of plantlets was zero (death of all plantlets received by farmers) due to the lack of differentiation of cultivation techniques and accompaniment from farmer between the plant *in vitro*

and the offshoots (the plantlets were planted in a field of cereal crops without basin and they were asphyxiated when watering) (Table 2). The mortality is higher in plants of Nejda (34.85%) compared to Boufegouss (30.99%) and Mejhool (15.05%) combined all sites.

Fig. 3a shows that the Bouffegouss variety has

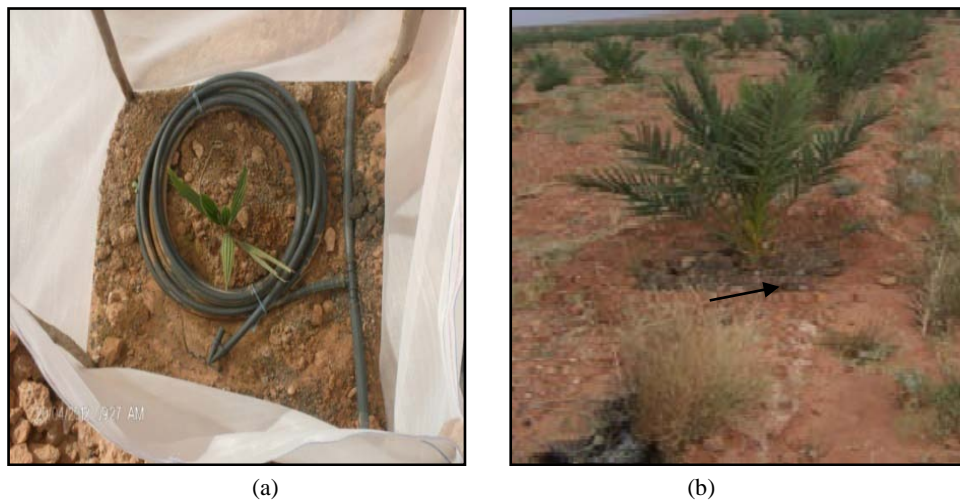
better adaptation in terms of shoot development in comparison with the Nejda variety (stage 1). On the contrary, in stage 2 the difference between the BFG and Mejhool is not significant (Fig. 3b).

Three years after plantation, an average of 43% of plants release offshoots and 14% produce inflorescences.

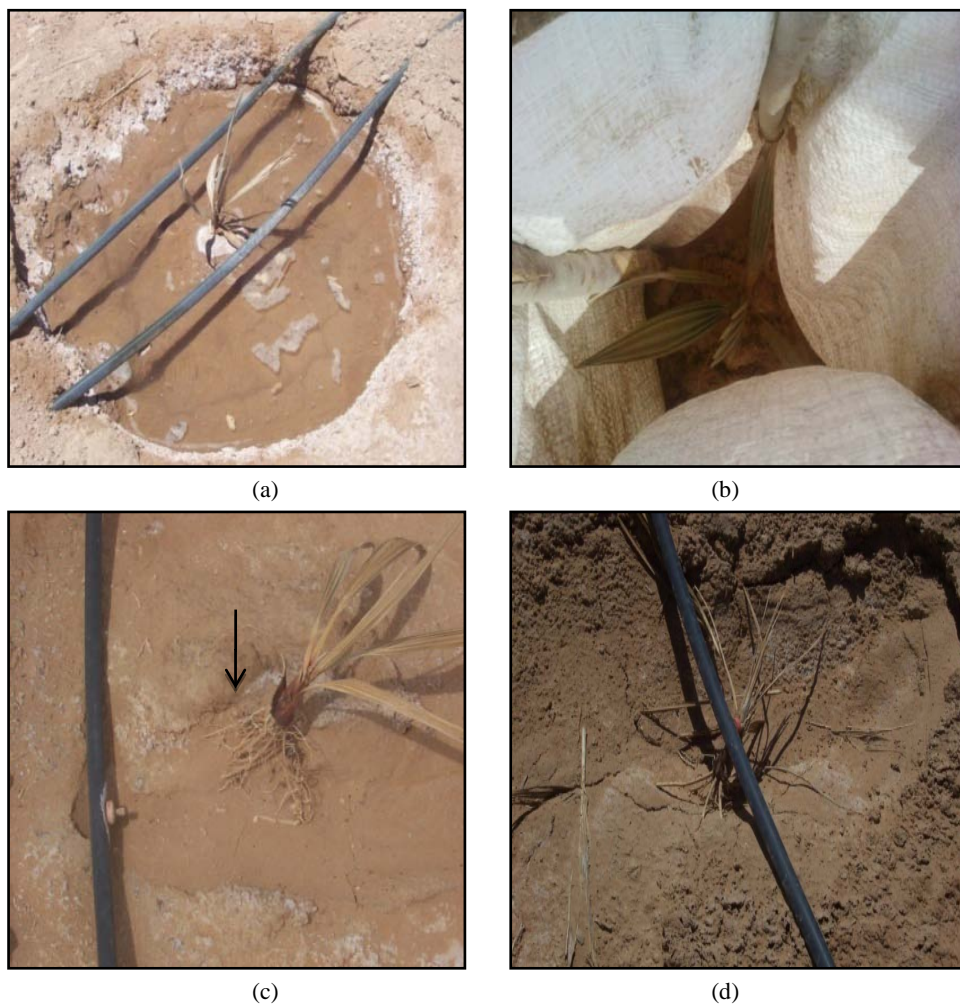
**Table 1 Cultural practices in different sites.**

	Site 1 (Aferdou)	Site 2 (Aferdou)	Site 3 (Sifa)	Site 4 (Lakhbata)	Site 5 (Lamaadid)
Type of plantation	Modern	Modern	Modern	Modern	Traditional
Varieties	Boufegouss (BFG), Nejda (NJD), Mejhool (MJHL)	BFG; MJHL	NJD; BFG	NJD; BFG	NJD; BFG
Number of plants	BFG: 462; NJD: 370; MJHL: 1024	BFG: 100 ; MJHL: 270	BFG: 814; NJD: 614	BFG: 102; NJD: 140	BFG: 147; NJD: 132
Plant spacing	8 m × 8 m	5 m × 6 m	7 m × 7 m	5 m × 6 m	The plantlets were planted in a field of cereal crops without basin and they were asphyxiated when watering
Time of planting	November 2012	November 2009	November 2012	November 2012	November 2012
Transplanting stage	BFG, NJD: Young stage (3 leaves, shoot height: 30 cm; <i>stage 1</i> ). MJHL: 3 years; <i>stage 2</i>	Young stage (3 leaves, shoot height: 30 cm; <i>observation made 3 years after planting; stage 2</i> ).	Young stage (3 leaves, shoot height: 30 cm; <i>stage 1</i> ).	Young stage (3 leaves, shoot height: 30 cm; <i>stage 1</i> ).	Young stage (3 leaves, shoot height: 30 cm; <i>stage 1</i> ).
Planting depth	The “heart” of the plant is not covered with soil	The “heart” of the plant is not covered with soil	Several plants presented a heart covered by soil (fig. 2a)	Many problems in technique of planting (plant heart positioning)	
Plant protection and shelter belts	-Use of hessian wrapping to protect young plantlets (fig. 1a). -Use of shelter belts	Lack of shelter belts	-Use of hessian wrapping to protect young plantlets (some problems in utilization of this technique) (fig. 2b). -Use of shelter belts	Lack of plant protection and shelter belts	
Irrigation system	Drip irrigation (fig. 1a)	Irrigation by gravity (fig. 1b)	Drip irrigation	Drip irrigation: many problems with maintenance of the irrigation system (fig. 2c and d)	Irrigation by submersion
Soil improvement and fertilization	The soil from the hole was mixed with bio-compost before planting. -Fertigation using: hydrocomplex NPK; BIOTRAC (Bore, Zinc; Azote, Potasse)	-The soil was mixed with organic material (spent olives, manure, and ash) before planting. -Manual fertilization using hydrocomplex NPK.	One manual application of fertilization (NPK) after plantation	No fertilization has been applied	No fertilization has been applied

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**Fig. 1** Irrigation type in date palm grove. Drip irrigation and plant protection (a); irrigation by gravity (b).



**Fig. 2** Technical problems in date palm vitroplants cultivation. Plant "heart" covered with water (a); wrapping too close to the plant (b); water flow not controlled causing plant death (c); root desiccate causing plant to die (d).

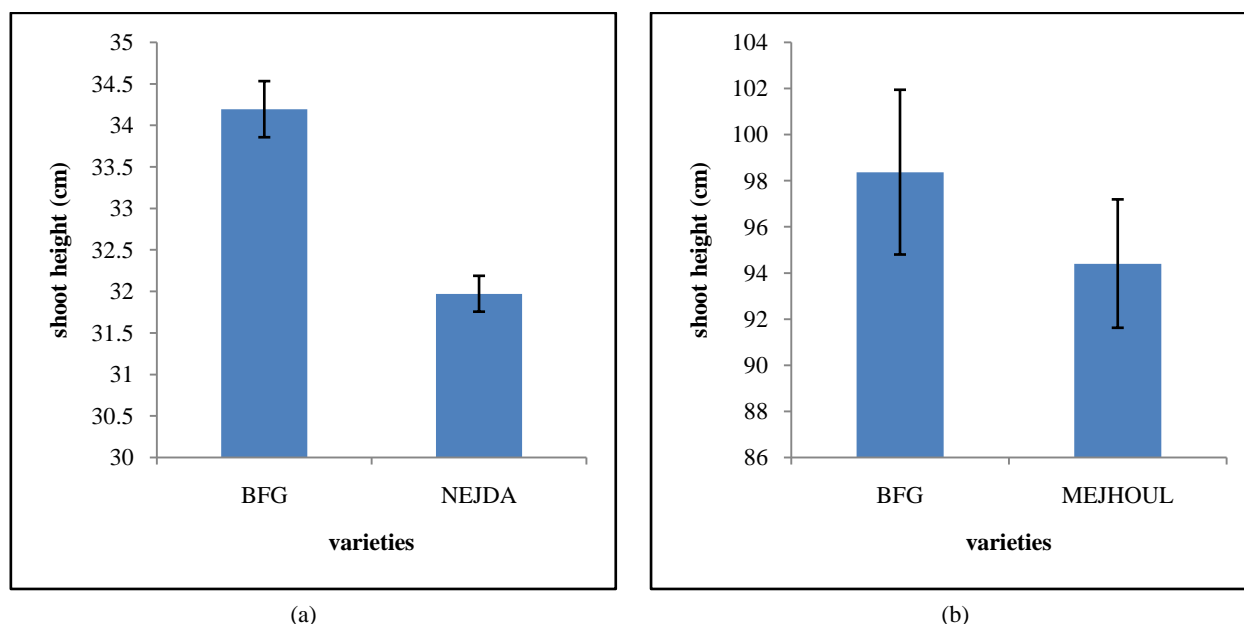


Fig. 3 Shoot height of plants in stage 1 (a) and stage 2 (b).

Table 2 Death rate according to the degrees of technicality.

Site	Degrees of technicality	Mortality (%)
Site 1	A	18.79
Site 2	B	26.25
Site 3	B	23.83
Site 4	C	77.91
Site 5	D	100

#### 4. Discussion

Date palm development program has set as a goal the reconstitution of old groves and the creation of the new modern plantation using vitroplants obtained by organogenesis. These plantlets require cultural techniques different from those used for offshoot plantation. According to Kleinand and Zaid [14], Alkhalifah et al. [15] and Sedra [13] to have a good survival rate and proper establishment of young tissue culture date palms need to master time of planting (February/March), transplanting stage (3 to 4 pinnae leaf stage), planting depth (the “heart” of the plant should never be covered with water), irrigation system installation (determined by availability of water), soil improvement and fertilization (the farmer must have an annual fertilization program) and protection and after care (the vitroplants should be protected from harsh climatic conditions). We noticed that for the site

1 which presents a good survival rate, all practices cited above are controlled. The lack of fertilization and adequate level irrigation water are the most problems causing plantlet death in the other sites. Indeed, to have a good growth, high yield and best fruit quality, date palm is usually fertilized with manure and inorganic fertilizers [16-18]. Regular applications of organic material improve water holding capacity and also the efficiency of irrigation [19]. The date palm requires a rather large quantity of water for a good growth. Liebenberg and Zaid [20] mentioned that quantities of water made available to date palm trees around the world vary from 15,000 to 32,000 m<sup>3</sup>/ha annually. In United Arab Emirates, Green et al. [21] concluded that mature date palms (var. Lulu) are using 150 L of water during the middle of summer and about 50 L during the middle of winter. In addition, Sedra [12] suggested for young plantlets

11,000 m<sup>3</sup>/ha such as annual average dose of irrigation. However, more precise information on water use by tissue culture derived plantlets is needed for sustainable date palm cultivation.

## 5. Conclusion

In conclusion, the mastery of cultivation techniques in date palm is a key step for the development of this sector in Morocco. Indeed, for good use of the new techniques of biotechnologies in date palm cultivation, a regular close supervision of farmer and a popularization of date palm cultural techniques are needed.

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