Principes, 37(3), 1993, pp. 151–158

On the Mediterranean Fan Palm (Chamaerops humilis)

M. E. MERLO, M. M. ALEMÁN, J. CABELLO, AND J. PEÑAS

Dpto. Biología Vegetal, E. U. Politécnica, Campus de Almería, Universidad de Granada, Spain

ABSTRACT

Chamaerops humilis L., a palm commonly found on the Spanish Mediterranean coast, is currently being used in gardening in preference to other palms of alien origin. This fact, together with its potential use for regenerating Mediterranean ecosystems, accounts for our interest in its propagation. Vegetative reproduction of this plant has not been successful, and seed-sowing seems to be the most convenient method. Previous reports indicate that seeds take 2 to 3 months to germinate. However, our experience shows that this period can be considerably shortened.

RESUMEN

En los últimos tiempos *Chamaerops humilis* L., palmera abundante en el litoral mediterráneo español, se está utilizando en la jardinería, con preferencia a otras palmeras de procedencia foránea. Esta circunstancia, así como su uso potencial en la regeneración de ecosistemas mediterráneos, nos ha hecho interesarnos por su forma de propagación. La reproducción vegetativa de esta planta no da buenos resultados, sino que, la forma más conveniente para propagarlo es por semillas. De acuerdo con la bibliografía consultada, las semillas tardan de dos a tres meses en germinar, sin embargo, nuestra experiencia demuestra que este periodo puede ser mucho más corto.

The generation of plant cover with native species, though highlighted in the past by some naturalists, is still an area of major concern. The present awareness has been brought about by the understanding that the surrounding landscape provides the most suitable species for planting. The surroundings will normally contain those species capable of using the environmental resources in the most balanced way without causing negative effects. This trend is also being followed by gardeners, who are increasingly including autochthonous species in their designs.

As supporters of the above idea, we have investigated the propagation of one of the most important species in the natural conformation of the "garigues" and "macchias" of the Mediterranean coastline, that is, the Mediterranean fan palm or "palmito" (*Chamaerops humilis* L.). We focused our research on seed germination, given the relatively long periods (2–3 months) required for its completion (Blombery and Rodd 1988).

Our interest in improving the propagation technique of this palm is further enhanced by the fact that it is one of the only two native palms in Europe and the only one in the Iberian Peninsula. It is also one of the very few palms the origin of which is not in the tropics (it reaches latitudes of up to 44°N).

Chamaerops humilis is a multi-stemmed shrub with short trunks, hence its name "dwarf palm." However, in gardens it can reach heights of 4 and even 6 m. The leaves, which emerge in a terminal tuft, have long woody stalks armed with thorns and fan-shaped blades which fold along the midribs. It is dioecious and blooms in spring, from March to May. The fruit is a globular reddish-brown drupe, oblong or ovoid, measuring 1–4 cm. The mesocarp is fibrous and very rich in butyric acid. Inside the fruit there is a single seed. The seed is very hard and has a single cotyledon which feeds the embryo during the first stages of germination. The palm yields fruits during summer–autumn.

Besides its potential use in regenerating vegetation cover in arid areas and its application as an ornamental plant in warm

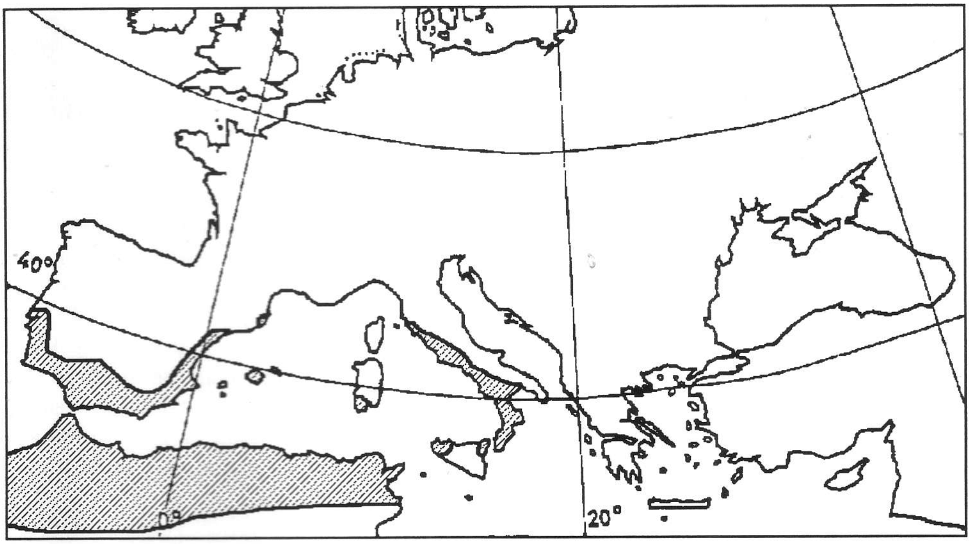
Map 1. Distribution of *Chamaerops humilis* L. in the Iberian Peninsula.

seaside regions, this palm has traditionally been used for other purposes (López 1982, Font Quer 1988, Mabberley 1990, Rivera and Obon de Castro 1991). The leaves of the adult plant have been used in basket-weaving to make mats, carrier baskets, and brooms. The young unopened leaves are treated with sulphur to make them softer and supple and are then used for finer work. The husk, known in southern Spain as "higa," is edible before its full development. The fruits have also been traditionally used in medicine as an astringent because of their bitterness and high tannin content.

Due to the current decrease of the ecosystems where this plant is naturally found, regulations towards its preservation have been passed in some areas. For example, in Murcia (southeast Spain), one of the leading Spanish regions for nature preservation, this palm is included in the list of protected species, which means that the whole plant or any of its parts including the seeds cannot be picked or cut deliberately; neither is it permitted to market or carry out any other activity in respect to this plant which can result in its destruction or damage, except for scientific, conservation, or craft (leaf collection) purposes.

Biogeography and Ecology

Distribution. It is a western steno-Mediterranean taxon. In the Iberian Peninsula it is distributed as follows: its most northwesterly boundary is in the Arrábida Mountains, south of Lisbon, and it is not found again until further south in Cape San Vicente; from here it extends uninterrupted to Cape of Gata and then northwards up to the delta of the river Llobregat, its most northeasterly border. Incursions



Map 2. Map showing the location of the *Chamaerops humilis* L. in the Mediterranean area.

inland into more continental areas happen only in Valencia, Alicante, Murcia, and, more extensively, in the Guadalquivir valley (Western Andalucía). Such boundaries in the Iberian Peninsula (Font Quer 1954) are explained by the nature of the substrate required by the plant and its inability to stand oceanic exposure or high levels of rain (Map 1).

In the whole of the Mediterranean, this palm is found on the north coasts of Africa, from Morocco to Libya; in the Italian coastal strip from Tuscany to the south; and at its most northern limit it is found in an isolated locality on the Portofino Promontory in eastern Liguria. It is also found on the islands of Sicily, Sardinia, and other smaller islands, its easterly boundary being on the island of Malta (Map 2).

Geology and Edaphics. The Mediterranean fan palm is most commonly found on limestone soils, although it can grow on siliceous substrata, as well as on granite rock (SW of Sierra Morena). It grows on all sorts of ground, such as hills, slopes, ravines, etc., always in sunny and dry locations where the substrate is sandy, marly or even rocky, but never covering dune areas.

Climate. It is a thermophilic taxon associated with coastal and subcoastal areas. It disappears, together with other thermophilic species in the same environment, as altitude and latitude increase and also with oceanic influence. Its distribution is conditioned by sensitivity to frosts and is, therefore, heavily influenced by latitude. In its most northern locations in the Iberian Peninsula it is hardly ever found at altitudes above 300–400 m, while in the southern parts it can be found above 1,000 m in S-SE facing areas of stony ground and little soil. According to Freitag (1971), fruits have been collected in the SE of Spain in areas as high as 800 m. Authors such as Jahandiez and Maire (see Font Quer 1954) report findings of this palm on the opposite Mediterranean coast in northern Africa, at 1,400 m in the Middle Atlas, and up to 2,300 m in the Great Atlas.

With regard to water tolerance, it can survive rain levels above 700 mm (see

Freitag 1971). Under optimum environmental conditions it can possibly stand rain levels of 1,000–1,300 mm and higher, but in this case its dominance is diminished because of competition of other species with higher water requirements. As for minimum levels of rain, the most important feature of the palmito is its ability to survive severe summer droughts. However, growing conditions cease to be optimum when annual rain levels fall below 150 (125) mm.

The ability to stand strong winds is also an important feature.

Occurrence and Associated Species. The Mediterranean fan palm (*Chamaerops humilis*) is a phanerophyte typical of the thermophilic vegetation found in the western Mediterranean basin and which, together with other species such as Carob (*Ceratonia siliqua*), olive (*Olea europaea*) and kermes (*Quercus coccifera*), are the most representative species of this region. From a physiognomic point of view, it is one of the most important determinants of the natural landscape of the coastal "garigues" and "macchias."

This palm can sometimes appear as a basic component of the phytoceonoses, representing either permanent communities or replacement stages of the planosclerophyllous woods, which abound in Mediterranean regions with rain levels above 400 mm. However, it is more commonly found in the chamaephyte state as part of thickets and spiny shrublands, not just because these are drier areas, but also because of the current deterioration of the Mediterranean vegetation caused by the action of man.

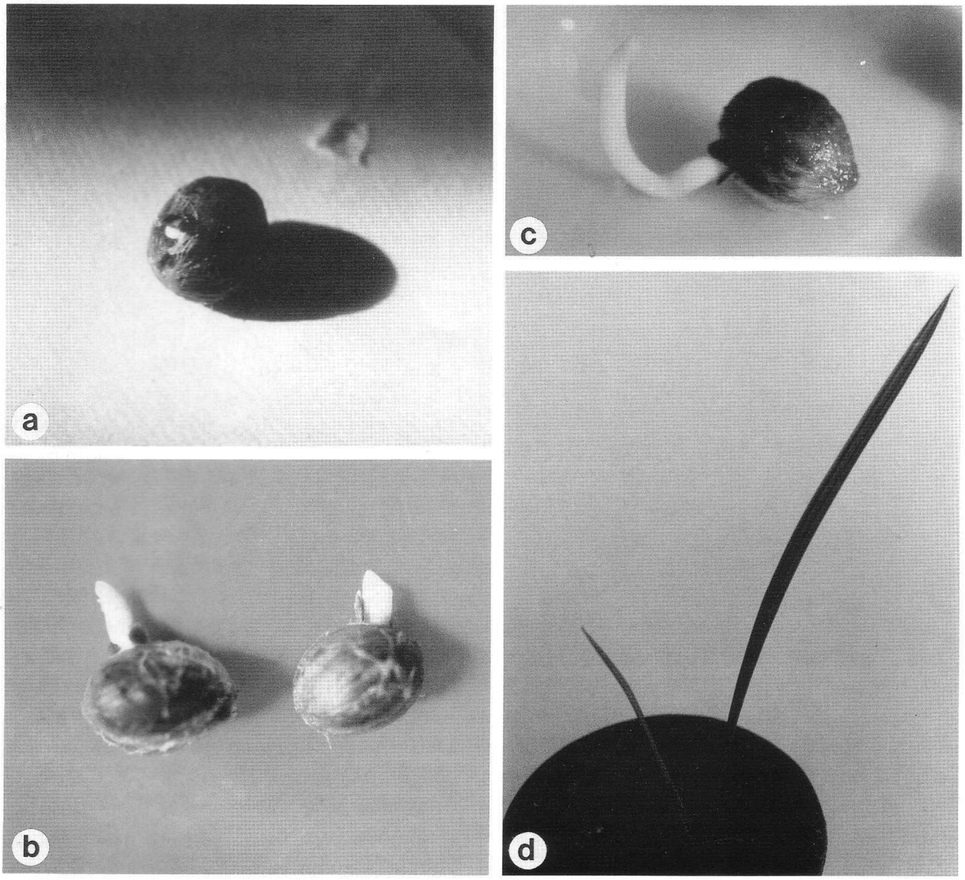
Although in the Iberian Peninsula this palm is not unequivocally associated with other species, it is, together with other taxa, a good bioindicator of the thermic peninsular strip which they cover. Among such thermophilic elements, it is worth mentioning the following shrubs and lianas: *Aristolochia baetica, Calicotome spinosa, Ceratonia siliqua* (spontaneous), *Clematis cirrhosa, Juniperus macrocarpa, J. navicularis, J. turbinata, Lycium intricatum, Maytenus senegalensis* ssp. *europaeus, Osyris quadripartita, Periploca laevigata* ssp. *angustifolia, Prasium majus, Rhamnus oleoides* ssp. *oleoides, Salix pedicellata, Tetraclinis articulata, Whitania frutescens, Ziziphus lotus, Olea europaea* var. *sylvestris, Myrtus communis, Pistacia lentiscus, Smilax aspera,* etc.

The palmito is to a greater or lesser extent represented in all thermophilic vegetation formations, except in those of sands. The surrounding flora varies according to the geographical region and the nature of the substrate.

Seed Propagation

Material and Methods. Flowering occurred during March–May and fruits were collected in September–October, 1990, in Cape of Gata, Almería, Spain. After collection, the fleshy fruits were selected according to size and appearance, extracted, and washed by hand in tap water. Fruit and seeds were then allowed to dry at laboratory temperature for 10–15 days, mixed thoroughly, and placed in dry container and stored at 4° C in darkness for periods of 2–4 months. For preservation purposes, fruits were kept in airtight glass jars containing silica gel in order to obtain an inert and dry environment.

Several germination trials were then carried out by subjecting the seeds to various preliminary treatments (Hartmann 1983). In all cases, fruits and seeds were first washed for a few minutes with a 1% solution of sodium hypochlorite and an excess of sterilized distilled water to prevent the risk of contamination, particularly by fungi. The washed seeds were left to germinate in Petri dishes (20 cm diameter) containing filter paper dampened with 10 ml of water or other solutions. Fruits or seeds were left to grow in germination chambers in darkness at 25° C and 70%



1. Appearance of palmito seeds (*Chamaerops humilis* L.): a) just after splitting of the protective coat; b) 8 days later; c) 12 days after germination; d) appearance of the seedlings 40 days after germination. Seeds have been planted into peat when they were 12 days old.

humidity. An average of 20 seeds was put in each dish. Tests lasted an average of 5 weeks, although in the case of some treatments, favorable results were obtained in as little as 7 days. Germination was considered to have taken place at the radicle emergence.

All glassware was sterilized prior to use in an oven at 120° C for 20 minutes.

A first or control test was carried out in which fruits did not undergo any previous treatment. This was not successful. In further tests, the outer coat of the seeds was softened (scarification) in order to enable gaseous exchange and water inbibition. Scarification can be carried out in two ways: either removing all or part of the fleshy cover (manual or mechanical scarification) and/or using chemical agents (chemical scarification).

Manual scarification is done by removing the fruit with a lancet, leaving the bare seed. Mechanical scarification is a similar process but much faster. The fruits are dipped in distilled water and shaken with an electric mixer for 2–3 minutes. After repeating this process once, the mixture is sieved and washed with excess water to

2. *Chamaerops humilis* L. in fruit.

separate the pericarp tissue from the seeds. Sterilized water was used in the final wash.

The seeds scarified by the above method were subjected to the control test (germination in sterilized water) or treatments with gibberellic acid (1,000 ppm), concentrated H_2SO_4 (96%) or 30% (w/v) NaOH rinsing after acid or caustic pre-treatments. Similar tests were carried out with non-scarified seeds. The results are shown in Table 1.

The seeds germinated by the above methods were placed in pots containing peat in nursery, and 95% continued to grow into normal seedlings.

In order to investigate the effects of temperature over the germination process, tests were carried out at 16° C, 25° C, and 30° C.

Results and Discussion

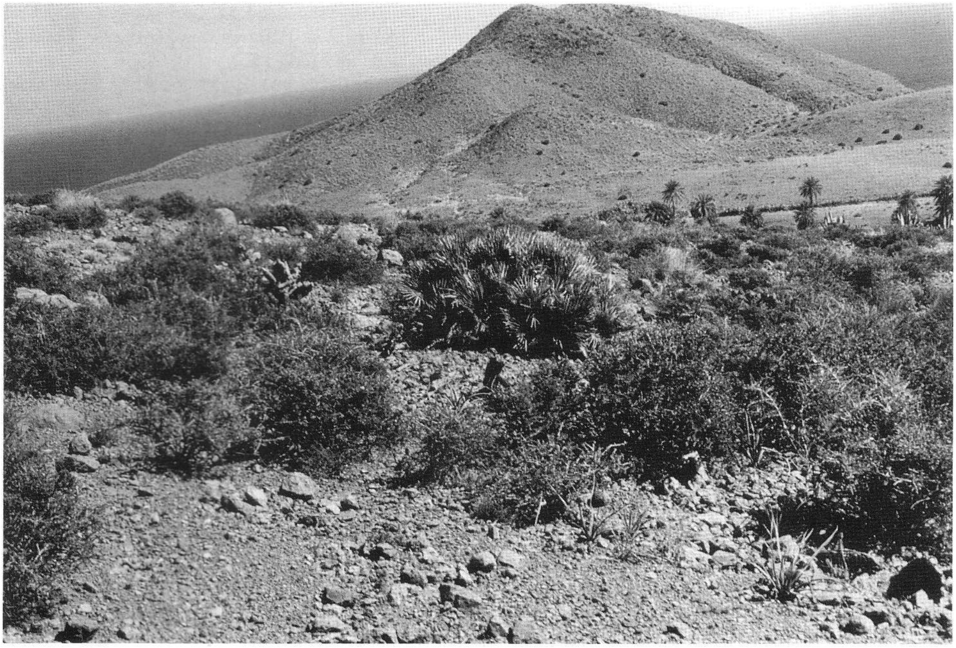
Table 1 shows a summary of the results obtained for the various treatments. Germination occurrences are expressed in percentages, and time in days.

Table 1. Germination pattern.

	25°C	
Treatment	% Germin.	Time (days)
Scarified seeds		
Manual		
Control	60	25
GA3	0	35
4.5 hours H_2SO_4 96%	90	7
3 hours NaOH 30% (w/v)	75	10
Mechanical		
Control	75	25
4.5 hours H_2SO_4 96%	67	7
3 hours NaOH 30% (w/v)	60	20
Seeds with flesh		
Control	0	35
4.5 hours H_2SO_4 (96%)	0	35
7 hours H_2SO_4 (96%)	80	35
3 hours NaOH 30% (w/v)	0	35
7 hours NaOH 30% (w/v)	15	35

The above tests allow us not only to study the germinating capacity of the seeds, but also to know the optimum laboratory conditions needed for the radicle to emerge. We can deduce in this way the environmental conditions which determine the germination process in the natural habitat during the development of the embryo. We can also establish whether dormancy occurs and to what extent (Bewley and Black 1982).

With regard to temperature, an important exogenous parameter in the germination process (Bewley and Black 1982), high percentages of germination were obtained at 25° C optimum, but considerably lower at other temperatures. Thus, 25% of the manually scarified seeds sown



3. *Chamaerops humilis* L. in its natural environment.

in sterilized water germinated at both 16° C and 30° C, while 60% germinated at 25° C. In the control test carried out with mechanically scarified seeds, germination was 35% at 16° C and 55% at 30° C, as opposed to 75% at 25° C. No germination could be induced in seeds with flesh at any of the temperatures attempted.

These results could be an indication of the way in which the germination process is affected by temperature under natural conditions. Account must be taken, however, of the fact that in nature temperatures undergo, not only seasonal, but also daily changes which have an immediate effect on many metabolic processes such as cell permeability and growth (Aldasoro et al. 1981), protein synthesis (Rodriguez et al. 1985), etc.

The best results were obtained when manually scarified seeds were treated with concentrated H_2SO_4 for 4.5 hours and then put in a germination chamber. Germination was 90% in just seven days, as opposed to 60% in 25 days for the control test in water. As can be seen in Table 1, good success rates, 75% after 10 days, are also obtained by treating the seeds with 30% NaOH for 3 hours.

In the case of mechanically scarified seeds, the control test gave good results in comparison with other tests (75% after 25 days). However, when mechanical scarification was combined with chemical scarification, in contrast to manual scarification alone, the success rate decreased (67% in 7 days after pretreating the seed with H_2SO_4 for 4.5 hours; 60% in 20 days with 30% NaOH). Germination time was also longer, which could be explained because mechanical scarification leaves the embryo exposed to damage by strong acid or alkaline agents.

In the tests carried out with whole fruits without removing the flesh, germination could only be induced by prolonged treatments with acids (after 7 hours treatment, germination was 80% in 35 days) and alkalis (15% in 35 days). An explanation for these results could lie in the similarities between our tests and the natural process. The fruits are eaten by animals and go through a digestive process of enzymatic attack, after which the bare seeds are released in the feces. In our treatment, the mesocarp of the fruits is degraded by acid and the seed is released. A longer exposure to acid could probably also accelerate germination.

It is not surprising that chemical scarification for a relatively short period, combined with either manual or mechanical scarification, is equivalent to chemical scarification for a considerably longer period.

We conclude, therefore, that in order to obtain seedlings in just a few days (one week), it is necessary to carry out manual scarification followed by treatment with acid for at least 4.5 hours. Mechanical scarification is also recommended, but in this case, seedlings do not appear until after 25 days. When whole fruits are used, 7 hour treatment with sulphuric acid is advisable. In all cases, a further incubation period at 25° C in darkness and 70% humidity is necessary.

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