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# Technical sheet on the culture carob tree (*Ceratonia Siliqua L.*) in Morocco

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## ABSTRACT

The carob tree (*Ceratonia siliqua L.*) is a Flowering Plant, dicotyledon belonging to the order Rosales, family Fabaceae. It is robust and rustic. It is an agro-forestry-pastoral species with significant socio-economic and ecological interests. In this chapter we have focused on drafting a technical description of the carob tree (*Ceratonia siliqua L.*) in Morocco.

**Keywords:** carob, angiosperm, agro-forest grazing and Morocco

## **Introduction**

The carob tree (*Ceratonia siliqua* L.) whose origin seems to be the eastern Mediterranean has been domesticated since 4000 BC, its extensive cultivation dates from at least 2000 BC), longevity is considerable (up to 200 years) ; it can reach up to fifteen meters in height (Ait Chitt and *al.*, 2007). The carob tree is an agro-forestry-pastoral species with enormous socio-economic and ecological interests.

With its ability to develop different strategies for adapting to water stress, this tree moved favorably in arid and semiarid. Mediterranean ecosystems are characterized by scarce and erratic rainfall and long dry summer periods. These climatic constraints combined with anthropogenic pressure, generally lead to degradation of plant cover and rapid soil erosion. To counter this scourge, save soil fertility and improve the living standards of the rural population, the use of multiple-use pioneering species like the carob tree, adapted to climatic hazards and that can be installed on marginal land in reforestation programs and restoration of degraded soils remains a good strategy (Rejeb 1995).

The annual world production, mostly Mediterranean, is estimated at 214 000 tonnes (FAOSTAT 2012). Morocco is the world's largest producer of carob and the second largest producer of cloves after Spain (Ait Chitt and *al.*, 2007).

Marketing is mainly provided by three regions: Marrakech, Agadir and Fez. The price of the carob varies between 5 and 9 DH / kg and that of seeds between 22 and 32 DH / kg. The export of Morocco in 2003 was 10 410 t clove, or the equivalent of 192 million DH (Anonyme, 2007).

### **1. Importance and growing area**

In Morocco the surface occupied by the carob tree is around 30,000 ha in 2008 (FAOSTAT 2010) for a production of 40 000 pods (FAOSTAT 2012). In Morocco, the carob tree is present in the form of natural or artificial plantations in the country up to 1150 m with the exception of very arid zones (Emberger and Marine, 1941 Metro and Wild, 1955; Quezel and Santa, 1962/1963; Guinochet and Vilmorin, 1984). It is encountered in the Western and Eastern Rif (AFICS 1996). The carob tree stands are integrated in order Pistacio-Rhamnenalia (Achhal and *al.*, 1980), which includes groups of matorrals wooded or shrubby clear and are either natural or introduced as generators species forests. The main spontaneous population of carob tree is located in the regions of Fez, Marrakech, Agadir, Essaouira, Taza, El Hoceima, Beni Mellal and Khenifra (Tafechna and Ait Ishaq), in association with olive, mastic tree, cedar or argan tree (Ait Chitt and *al.*, 2007).

Table 1: carob production in the world and the Mediterranean Basin 2000-2011 (FAOSTAT 2012)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Spain	93863	73211	74736	67403	79200	64100	70000	72000	72000	60 795	95 000	75 000
Italy	38079	16282	24015	18637	19060	31665	26110	32784	31224	31 224	45 000	30 000
Greece	20192	16464	15015	14789	14594	14815	14506	15000	15000	15 822	12 000	10 000
Morocco	23000	24000	24000	25000	25000	25000	25000	25000	25000	19 472	75 000	40 000
Portugal	20000	20000	20000	20000	20000	22000	20000	23000	23000	21 000	45 000	45 000
Turqey	14000	13500	13500	14000	14000	12388	12000	12161	12100	12 097	18 000	14 000
Cyprus	7300	2850	7200	6550	6250	5650	6942	3839	3915	6 519	-	-
<b>World</b>	<b>226829</b>	<b>177787</b>	<b>188070</b>	<b>174365</b>	<b>186595</b>	<b>181830</b>	<b>184115</b>	<b>193250</b>	<b>191167</b>	<b>166929</b>	<b>290000</b>	<b>214000</b>

## 2. Agroecological requirement

The carob tree, whose range extends into the areas of plateaus and highlands up to 1700 m above sea level, is indifferent to the nature of the substrate; it tolerates soils, poor, sandy, loamy heavy, rocky, limestone, slate, sandstone and pH of 6.2 to 8.6; but fears acidic soil and high humidity (Baum, 1989; Sbay and Abrouch, 2006; Zouhair 1996). It adapts to many soil types except waterlogged and saline soils and schistose crusts. It occurs on marl soils, poor soils and shallow rocky limestone, on rocky slopes, inaccessible cliffs and barren hills (Nabli, 1989). Studies of Rejeb (1995) confirm that the carob behaves as a true species resistant to drought by morphologically and physiologically adapted to water shortages. The main modifications can be summarized as follows: i) the stomata are located on one side, ii) the number of stomata is quite high and they are small, iii) the root system is developed, iv) a deposit of wax large, v) uptake and gas exchange depend on the general water status.

## 3. Biology and reproduction

The carob tree is a sclerophyllous tree or shrub, evergreen, which can reach 7-20 m in height and a circumference at the base of the trunk 2 to 3m. It has a smooth, gray bark when the plant is young, brown and rough in adulthood. Its reddish wood is very hard. The carob tree can live up to 200 years (Ait Chitt and al., 2007). The leaves of 10 to 20 cm long are characterized by a petiole furrowed on the inside and a spine carrying 8 to 15 leaflets, opposite of 3 to 7 cm long, they are tough, entire, oval to elliptical, paripinnately. The flowers are greenish, small (of 6 to 16 mm in length), spiral and combined in a large number to form clusters and axillary lines, shorter than the leaf axils of which they have developed (Batlle and Tous, 1997). The fruit of the carob tree grows very slowly need 9 to 10 months to reach maturity. It is large, of 10 to 30 cm long and of 2 to 3.5 cm wide and indehiscent after maturity. It is green and then brown when mature, dark brown to black. The pod is separated inside by pulpy partitions and contains 12 to 16 seeds whose length and width are 8 to 10 mm and 7 to 8 mm respectively (Batlle and al., 1997). The carob tree is dioecious, sometimes hermaphrodite. The male plants are sterile and unproductive. This aspect has been well studied by Schroeder (1959), he is considered the only Mediterranean tree bloom in summer: from August to October (Aafi, 1996) or autumn: from September to November (Fournier, 1977). The carob flower pollination is largely carried by insects (Retana et al., 1990, 1994; Rejeb et al., 1991; Ortiz et al., 1996) but also by the wind (Passos de Carvalho, 1988; Tous and Batlle 1990).

## 4. Multiplication

It can be done by seed, cuttings, grafting, or by micro-propagation.

**Sowing:** This is a classic method most used to propagate the carob tree. Indeed germination from seed is easily achievable, but is hampered by the inability to know the sex of the plant before maturation and late production, which can take more than 8 years (Rejeb 1995; Gharnit, 2004 and Ait Chitt and *al.*, 2007).

**Cuttings:** This is a technique used less because it requires very thorough and high temperature edaphique care (Rejeb 1995). Cuttings involve removing portions of twigs under specific conditions allowing them to form a bark ridge and you can make root (Baillière, 1975).

**Grafting:** It involves grafting male's feet by females. Indeed it is to transfer the shoots collected on the female plants and grafting on the male plants. This method allows the male trees bear fruit from the third year of producing breeds guaranteeing fruiting and maintaining compliance of characters selected from the mother plant (Gharnit 2004; Ait Chitt and *al.*, 2007)

**In vitro culture of the carob tree:** This is a promising technique, which provides a plant in conformity with the original plant; it was made from seedlings and adult plants (Sebastian and McComb, 1986; Batlle and Tous, 1997), as well as various explants: nodes taken from germination plantlets (Belaizi et *al.*, 1994), axillary buds ... (Saidi et *al.*, 2007).

## 5. Uses the carob tree

The carob tree is an ecologically important tree, socio-economic, industrial and ornamental indisputable. In terms of products, the tree and all its components (leaves, flowers, fruits, seeds, wood, bark and root) are useful and particularly the fruit. Because of its hardiness and adaptation to environmental constraints, the carob tree is often used for afforestation and reforestation of areas affected by erosion and desertification (Boudy 1950; Rejeb 1991; Biner et *al.*, 2007). It is also used as an ornamental plant along roadsides and in gardens (Batlle and Tous 1997). In producing countries, carob pods have traditionally been used not only in feeding ruminant animals (Louca and Papas, 1973) or non-ruminant (Sahle et *al.*, 1992), but also in human food. The pulp is used in the human food industry, thanks to its high content of sugars and phenolic compounds. It is also used for the production of alcohol (ethanol), citric acid and cocoa as substituent for the manufacture of chocolate, since it contains no caffeine or theobromine (alkaloids). The flour of the pulp in the composition of many foods as, biscuits, milk flours. (Rejeb *al.*, 1991;. Youssif et *al.*, 2000; Makris and Kefalas, 2004; Dakia et *al.*, 2007). In traditional medicine, the pulp is used against diarrhea and for the treatment of certain diseases such as gastritis, enteritis, tonsillitis, colds, cancer (Crosi and *al.*, 2002; Gharnit 2004; Ait Chitt and *al.*, 2007).

All components of the seed of the carob tree (seed coat, endosperm and cotyledon), play an important industrial and medical role, but gum (endosperm) remains the most important, since it is used as stabilizer, gelling agent, fixer in different areas such as food (cheese, mayonnaise, salads ...), cosmetics (creams, toothpaste ...), pharmaceuticals (medicines, syrups ...), tanning, textiles. (Batlle and Tous 1997; Biner and *al.*, 2007; Dakia and *al.*, 2007).

The other parts of the tree are also used; in fact, the flower is used by beekeepers to produce honey locust honey or autumn, when the leaves are useful for animal feed. The bark and roots are used in the tanning industry thanks to their tannin content. The wood of the carob tree, hard red, is estimated in the Carbonari and joinery (Rejeb *al.*, 1991; Gharnit, 2004).

## **7. Harvesting and conservation**

Traditionally harvesting is done in our region by shaking down from the tree or by mechanical harvesting by trunk shakers and manpower shakers. Green pods are formed in September-October but not until maturity in July-August of the following year for harvest.

The main purpose of this conservation is to preserve the diversity of several genotypes of carob. Worldwide, there are eight areas of carob collection (table). Spain has the largest number of collections about 280 local accessions and thirty foreign sources. These accessions are protected in four different regions by their type of Mediterranean climate (Batlle and Tous 1997). No conservation information carob especially in countries like Morocco, Italy, Cyprus and others (Konate, 2007). Micro-propagation in vitro was also developed as an alternative for preserving the carob Australia (Sebastian and McComb, 1986), Spain (Alorda and Medrano, 1996), Tunisia (Belaizi and *al.*, 1994) and Morocco (Gharnit 1997; Konate, 2001).

**Table 2:** World carob germplasm collections (Batlle et Tous, 1997)

Country	Place district	Area (ha)	Planting year	Accessions		Evaluation
				Native	Foreign	
<b>Spain</b>	Reus, Tarragona	1	1987	52	16	Phenological, agronomic, commercial characteristics and yield
	Tortosa, Tarragona	0.8	1989	59	12	Yield
	Palma, Majorca	0.5	1986	39	1	Phenological characteristics, fruit quality and yield
	Villajo yosa, Alicante	1.5	1986	133	2	Agronomic characteristics Pomological characteristics and yield
<b>Portugal</b>	Tavira, Algaré	0.5	1988	11	2	
<b>Tunisia</b>	Ariana	-	1950	10	-	None
<b>USA</b>	San Diego, California	-	1960	2	3	None
<b>Australia</b>	Loxton, S. Australie	0.3	1985	-	10	Yield

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