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SWEET CHERRIESAND AGROECOLOGICAL REQUIREMENT

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Abstract: The development of sweet cherry tree (*Prunus avium* L.) cultivation is hampered by two major constraints, namely the chilling requirement and the gametophytic self-incompatibility of certain varieties. In order to contribute to the development of this high value-added crop capable of playing a socio-economic role in the rural and peri-forest environment we must know the varietal mixture to be installed and a broad knowledge of its adaptation in the growing region. This review study focuses on the classification,and requirements of cherry trees for good production. Also, Suggestions are made on planting and care of sweet cherries

Keywords

Varietal mixture, *Prunus avium* L., chilling requirement, production.

INTRODUCTION

Agro-biodiversity within domesticated species results from different mixing and selection. Global warming can seriously affect the production of fruit trees due to the incomplete satisfaction of their chilling requirements (Campoy et al., 2011). It results in particular with a rise of temperatures in autumn and winter (IPCC, 2013). In many perennial species, it has been demonstrated that a rise of temperatures during periods of dormancy and emergence from dormancy (fall, winter) was responsible for a disruption of phenological stages with the activity of pollinators and a modification host/pathogen relationships (Hanninen and Tanino, 2011; Luedeling, 2012).

Man has always learned to discern among spontaneous species those which best suit his needs; he has domesticated certain plant species which are useful to him (nutrition, clothing, medicine, etc.). Among these species we can cite the cherry tree which is a hardy species capable of adapting to various soil and climatic conditions; but its development is limited by some physical, climatic and physiological constraints. Sweet cherry (Prunus avium L., Rosaceae, 2n = 2x = 16), is an allogamous species.

For this reason and to cope with climate change, two scenarios are mentioned to maintain sustainable production: there will be a migration of species depending on future climate forecasts or the creation of new varieties adapted to the conditions that could arise.

Cherry production is approximately 2.2 million tonnes produced worldwide in 2009 (Anonymous, 2010). Around 40% of global cherry production comes from Europe. The main cherry producing countries are

Turkey, the United States, Iran, Italy and Spain (Anonymous, 2010). Cherry cultivation in Tunisia covers an area of approximately 961 ha (DGPV, 2016). Sweet cherry is grown particularly in the continental regions of northern Tunisia, where winter is cool and spring frosts are rare. National production is 5,200 tonnes (DGPV, 2016).

The morphological characterization of the sweet cherry tree was carried out by Christensen (1969, 1970, 1974, 1985). This author morphologically evaluated different varieties and proposed a code for their identification. Other authors have also studied the morphology of sweet and sour cherry trees such as Fogle (1961). Variety descriptors were developed by IPGRI (1985) and UPOV (1976). The identification and characterization of different varieties of cherry should help make rational choices and contribute to the conservation of genetic resources necessary for subsequent improvement work. In Tunisia, studies carried out on the cherry tree are still few in number. The local variety is poorly valued given the predominance of introduced varieties which have high productivity and good adaptation to the mild North African climate.

1. Presentation of cherry tree (Prunus avium L.)

1.1. Mythology

According to archaeological data, agriculture appeared between 10,000 and 8,000 BC (Before Jesus Christ), with the first cereal crops (Harlan, 1995). A thousand years later, we saw the first domestications of cereals and legumes (Zohary & Hopf, 2000). It was only around 4000 BC that the first fruit trees were domesticated in the east of the Mediterraneanbasin.It was not until 1000 BC to observe the first domestications of cherry tree. The cherry trees will then be selected for their large and sweet fruits, and a habitstockier, favorable for harvests. Some authors place the center of domestication ofcherry tree in the Caucasus region near the Black Sea, other authors place it in Greece(Hedrick et al., 1915). The domestication of the cherry tree would be multi-site, introgressions from wild forms (cherry trees) after domestication cannot be excluded. Thiswhich complicates the patterns of diversity expected under the sole effects of domestication(Tavaud, 2002, Castède, 2014).

1.2. Origin

Wild sweet cherry trees are native to the region between the Black Sea and the Caspian Sea. They were known in Western Europe well before antiquity (Jarreau, 2006). These seeds were distributed in Europe by the Romans at the beginning of the first century. French settlers introduced cherries to the Canadian maritime provinces. In the literature, it has been reported that cherries were grown in abundance in Virginia during the second half of the 17th century (Marini, 2009). The spread of the sweet cherry tree in Europe and Asia was also made by the birds from which it takes its name (Lespinasse et al, 2011).

The *Prunus avium L*. tree is of good vigor, generally with an erect habit, can reach 25 to 30 m high in forests, and 15 m in orchards. The size of the fruit varies greatly. Their taste is most often sweet but sometimes bitter. In the cultivated compartment of *Prunus avium* we distinguish between cherries with firm flesh (bigarreaux) and those with soft flesh (guignes).

1.3. Taxonomy

The cultivated cherry tree belongs to the Rosaceae family, the broad genus Prunus and the subgenus Cerasus. The species P. avium is a diploid species (2n=16) (Breton, 1972), whose cultivated form consists of sweet cherry trees.

Classification of sweet cherry according to Souayah (2009)

Reign; Plantae;
Under reign; Tracheobionta
Class; Magnoliopsida
Family; Rosaceae
Subfamily; Prunoideae
Genus; Prunus

1.3.1. Classification

The genus Prunus consists of more than 200 species with a base chromosome number x = 8. It belongs to the subfamily Prunoideae of the family Rosaceae (Rehder 1940), and probably originated in Central Asia (Watkins 1976). In the subfamily Prunoideae fruits are formed from the ovary of a flower which gives a fleshy fruit whose core is the endocarp. Until today, the classification of the cherry tree is based on morphological parameters such as the presence or absence of a furrow on the fruit, the number of axillary

buds on the branches, the length of the peduncle, the shape of the fruits and common inflorescence characteristics.

The genus "Prunus" was initially assigned to plum trees by Linnaean botanists and then was gradually extended to stone fruit species. Lee and Wen (2001) cited that Tournefort (1700) created the first classification of the genus Prunus by proposing six genera depending on fruit morphology: Amygdalus, Armeniaca, Cerasus, Laurocerasus, Persica, and Prunus.

"Linnaeus (1753) identified three genera: Amygdalus, Padus and Prunus and a year later, Linnaeus (1754) accepted four genera: Armeniaca, Cerasus, Padus (including Laurocerasus), and Prunus. Since then, many other classifications have been proposed for the genus Prunus, and many classifications have treated the genus Prunus as a single genus that consists of several subgenera or sections (Janick, 2011; Rehder, 1940; Robertson, 1974).

Research continues on the Prunus genus classification with the contribution of molecular biology" (El Debbagh, 2016).

The most widely used classification of the genus Prunus is that of Rehder (1940). This classification is adopted by several researchers (Bate-Smith 1961; Bortiri et al. 2006; Lersten and Horner 2000; Robertson 1974; Yu et al. 2007). It consists of dividing the genus Prunus into five subgenera: Amygdalus, Cerasus, Laurocerasus, Padus, and Prunophora, which themselves include twelve sections in total.

The two main species of cherries are the sour cherries « P cerasus » and the sweet cherries « P avium ». They are diploid and self-incompatible. Their places of origin is an area between the Black Sea and the Caspian Sea which includes Asia Minor, Iran, Iraq and Syria, and then gradually expanded from this origin to more other places by human and animal immigration (Lezzoni 2008).

1. 3. 2. Botanical characteristics

The cherry tree is characterized by a powerful trunk around which well-defined layers of branches are organized. The trunk as well as the branches are erect. They carry short branches laterally called "May bouquets" because their development is generally completed at the end of May. The flowers appear in all cases at the base of the annual shoots of the previous year, whether long shoots from the trunk and branches or May bouquets. On a cherry tree a few years old, most of the flowering and therefore fruit production is carried by the May bouquets. The good development of these May bouquets is therefore very important to maintain quality of cherry production (Eric Roose et al 2010).

Plants of the Prunus genus are deciduous or evergreen shrubs or trees. They are characterized by simple leaves, with toothed or entire edges, their morphology varies from one species to another as does their inflorescence which varies from a solitary flower to an umbellate cluster or a raceme and a white color going through all the shades up to pink.

The flower of this genus is generally characterized by the following traits: flower
of 5 petals and 5 sepals, solitary carpel with a terminal style (Yu et al. 2007). It is a hermaphrodite flower and the fruit is a drupe (Spencer et al., 1995). These drupes are most often edible and delicious but sometimes bitter or harsh (cherries, sloes), more rarely toxic (cherry laurel fruits).

The species is characterized by:

- a trunk with smooth bark detaching circularly.
- deciduous, alternate, toothed, stipulated leaves.
- flowers sometimes solitary (generally sterile), but often grouped in 2 accompanied by a wood eye, or even in 6 to 8, forming an inflorescence.
- a fruit which is a fleshy spherical drupe, with a smooth and shiny skin enclosing a hard core containing a bitter almond.
- the different productions which are:

The gourmand, characterized by its vigor and the size of its wheelbase.

The ordinary wood twig having only wood eyes.

The anticipated branch results from the development of a wood bud in the same year of its formation (Mahi Tani, 2006).

The mixed branch with wood eyes and flower buds

The floral branches, more or less long, without vegetation at their lower part, garnished with fruits on the middle part.

The May bouquet ensures the majority of fruiting. It only appears on mature subjects

Photo. 1.A whorl is formed between two-year-old wood (Year N-2) and one-year-old wood (Year N-1).). (Azizi-Gannouni Thouraya, 2018)

1.4. The cherry tree, a plant of agronomic interest

1.4. 1. Global production

The main cherry producing countries are shown in Table.3. According to FAO (2012), the global production of sweet cherries was estimated at 2,185,881 metric tons. A rapid increase in cherry production is due to high consumer demands, leading to the increase in their cultivation worldwide.

Table1.3. Main cherry producing countries in 2009 (Tons).

Contries	**Production (Milles tons)**
Turquie	417,7
États-Unis	390,7
Iran	225
Italie	116,2
Espagne	96,4
Syrie	78,3
Russie	69
Roumanie	67,9
Uzbekistan	67
Chilie	56
Allemagne	39,5
Ukranie	53
France	53,6
Pologne	50,5
Gr	48

Source: (FAO, 2014)

1.4. 2. Production in Tunisia

Cherry cultivation in Tunisia covers an area of approximately 961 ha. It finds its place particularly in northern continental regions where winter is cool and spring frosts are infrequent. National production is 5187 tonnes/year (DGPV 2016).

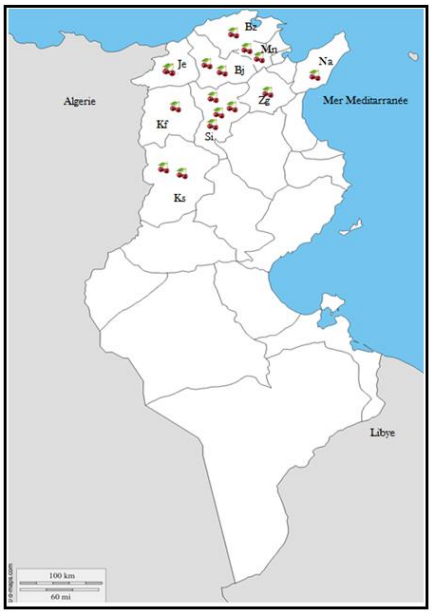

Figure2. . Geographical distribution of Tunisian sweet cherry production
(Jendouba (Je); Beja (Bj); Kasserine (Ks); Zaghouan (Zg) Siliana (Si) ; Nabeul (Na) ; Kef (Kf) ; Manouba (Mn) ; Bizerte (Bz))(thèse Azizi Thouraya, 2018)

Table 4. cultivated areas, production and number of plants of the sweet cherry tree (P avium) in Tunisia.

	area (ha)	**Production (tons)**	**Numbe of tree**
Manouba	8	30	3800
Nabeul	7	7	1400
Bizerte	14	15	3275
Beja	20	75	6700
Jendouba	26	58	8300
Kef	140	56	2400
Siliana	700	4800	280000
Zaghouan	4	6	1000
Kasserine	42	140	8000

Source : Ministère de l'agriculture 2016

1.5. The different rootstocks of the cherry tree

A good rootstock is one that has: 1) good affinity with the variety 2) resistance, particularly against fungi in the soil and disease-transmitting nematodes 3) positive influence on fruit set and yield 4) not or little release production 5) low sensitivity to variable soil characteristics (e.g. high pH values). In addition, the roots should be well anchored in the ground to prevent mechanical harvesting from causing too much damage (www.faw.ch).

Cherry rootstocks behave differently depending on soil and climate conditions. Depending on the production areas and farms, the qualities expected of a rootstock are significantly different (Gautier, 2009). Two rootstocks are commonly used to propagate the cherry tree: wild cherry and Mahaleb or Sainte Lucie (Gautier, 2009).

- Wild cherry has an excellent affinity with sweet cherry trees: bigarreaux and guignes. It gives trees good vigor, allowing great development and longevity of the trees, but fruit set is slow. It prefers silico-clay soils

and loam, deep and permeable soils. Fears limestone, drought and overly clayey soils. The bigarreautier, more demanding than the guignier or the griottier, prefers a soil of good constitution.

- Saint Lucia (Prunus mahaleb), characterized by its low vigor facilitating the collection of fruits, it can in certain situations take on a strength comparable to that of the cherry tree, it has a good affinity with sour cherries: morello cherries, amaranths, but mediocre with sweet cherries, it adapts to poor soils, but fears humid lands; we will exclude it from heavy or poorly drained soils, it induces a rapid fruit set, and gives fruits of good size.
- Sainte Lucie 64 is a clonal selection from Mahaleb, Sainte-Lucie 64, is characterized by good vigor. Good affinity with sour cherries and English cherries. It is a good rootstock in soils prone to drought. Its pivoting rooting allows it to adapt to dry and calcareous soils. Growing cherry trees on this rootstock is not recommended in humid soil (Fauré and Bretaudeau, 2008).

1.6. Agroecological requirements

1.6.1.Ecological requirements

1. 6.1.1. Climatic requirements

Mzali et al. (2002) showed that sweet cherry is less resistant to winter cold than sour cherry. However, damage to the roots would only appear above -10°C. It also depends on the rootstock. It is considered the high altitude tree where the quantities of cold are sufficient (>1500 hours at t°<7°C) to satisfy the cold needs of most varieties. Temperature plays a fundamental role in the process of fruit setting, pollination and fruit formation. Sensitivity to spring frosts differs depending on the varieties and phenological stages. The maximum sensitivity stage is that of young fruit (-1°C).

The cherry tree is a species characterized by the precocity of its harvest, hence the low water requirement. In areas receiving less than 500 mm of rainfall, irrigation should be carried out during the dry season to ensure good vegetation growth (Mzali et al., 2002).

Cherry cultivation can be carried out under rain-fed conditions in humid to sub-humid regions. To improve fruit quality and have a good yield, it is recommended to grow this crop irrigated or with supplemental irrigation.

In irrigated conditions, requirements vary depending on rainfall and are of the order of 2000 to 3000 m3 per hectare. However, we can estimate the water inputs to be provided at each stage of tree vegetation and according to their age based on the potential evapotranspiration ETP and the coefficient (Kc; crop coefficients). With supplementary irrigation, we can practice 2 to three waterings of 1000 to 15,000 m3/ha, 1 or 2 waterings during fruit growth and 1 watering after harvest (Jraidi et al., 2002).

1.6. 1. 2. Soil requirements

Like most plants, the cherry tree requires good porosity of the soil ensuring the circulation of air and water in order to condition the development of the roots. The types of soil suitable for cherry trees vary depending on the rootstock. In all cases, they must be well drained. A medium texture with good porosity is ideal for cherry. Whatever the rootstock used, the heterogeneity or shallow depth of the soil prevents normal root development (Mzali et al., 2002).

All soils are suitable for it, except those that are too clayey and impermeable. A good silica-clay loam is ideal. Not fearing limestone, it allows the development of soils abundantly provided with this element. Bigarrotier is more demanding since it prefers soil with good physical constitution (Bretaudeau et al.,1991).

based on the rootstocks of Saint Lucia and Cherry requires deep soils with a light to medium texture. On the sour cherry tree, it can withstand heavy but filtering soils. Thus, it can be cultivated on a wide range of soils provided that they are not compact, swinging and hydromorphic because the cherry tree is sensitive to root asphyxiation (Jraidi et al.,2002).

1.6.2 Agronomic requirements

1.6. 2.1 pruning

Cherry tree pruning is done during the summer months. It improves photosynthesis following better lighting. Water consumption decreases by reducing leaf surface area. Pruning during the summer reduces nitrogen requirements because the development of wood and leaves requires more nitrogen than that of fruit. By accentuating photosynthesis, summer pruning improves the accumulation of hydrocarbon reserves which are thus immediately available at the start of activity in the following spring (Bretaudeau et al., 1991).

1.6. 2. 2. Irrigation and fertilization

Water, nitrogen and potassium are among the major elements which have a strong effect on the development of the tree (branching and growth), floral induction and fruit development (photosynthesis). It is necessary to carry out chemical analyzes to ensure the richness of the soil in other elements.

The growth of new shoots begins mainly from the end of April to the beginning of July; the presence of water, nitrogen and potassium in the soil during this period will make it possible to obtain vigorous trees expressing their genetic potential. Throughout the period between harvest and leaf fall, feeding must be correctly monitored: in particular, it is during these months that most of the irrigation takes place due to the fact that the water reserve in the soil is often exhausted.

After the harvest, the reconstitution of the tree's reserves is necessary to start the following year in good conditions (flowering and fruit set). We will add 20 to 25% of the annual dose of manure at this time (Lichou et al.,1997).

Mineral nutrition is essential to improve the quality of the fruit and ensure good growth of the tree. It will be necessary to establish links between the nutritional state of trees and edaphic factors based on the chemical analysis of soils and to establish a relationship between mineral elements, tree growth and pomological parameters. .Leaf analyzes are a valuable approach to assess the nutritional status of trees. The trace and microelement composition of the leaves is an indicator of the mineral nutrition of the tree. Any excess or deficiency in relation to organic nitrogen fertilization could have direct consequences on the orchard: parasitism but also stimulation of alternation, reduction or excess of vigor and drop in yields (CTIFL, 1999).

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