THE ACTUAL STATUS OF CHERIMOYA CULTIVATION IN MADEIRA ISLAND

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INTRODUCTION

The only *Anonaceae* cultivated in Madeira Island since ancient times is *Annona cherimola* Mill. M. Grabham, that in 1887 describes how the crop was conducted, on the "Journal of the Jamaica Agricultural Society", made the first documented reference on this specie in Madeira.

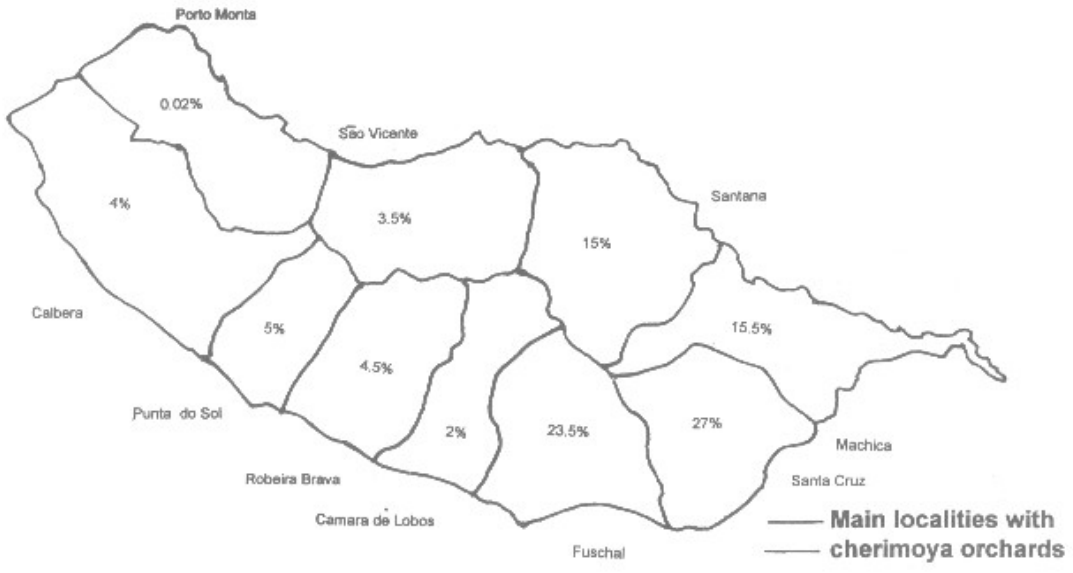
The first cherimoya were established up to 300 meters high, on the south cost or in lands at sea level on the north cost. In our days, this crop has its distribution up to 550 m on the south cost and 280 m on the north cost.

According to the last agriculture census (1989), cherimoya occupied 76.7 ha, being Madeira's Southeast and Northeast the major contributor with 80% of the total area planted with this crop. In 1996, according to data of the Direcção Regional de Agricultura, 950 t was the estimated production in an area of 85 ha.

Cherimoya, has being a unique fruit, because it's organoletic characteristics and it's nutritional value, was considered by Mark Twain as "deliciousness by itself" and the botanical Seeman stated that "the pineapple, mangostin and cherimoya are considered the most tasty fruits in the world". The Portuguese fruit-culture "father" Vieira Natividade, when referring to this fruit, said that it was "for sure the only food of the goods that the small humans were able to know".

Traditionally, the propagation was carried out by seed, originating strong plant variability shown by the five botanical types and their fruit quality.. Because of that, there are people that consider Madeira Island as one of the cherimoya's major genetic diversity pools in the world. Presently vegetative propagation has benefit from the immense genetic variability. With the enormous amount of material few varieties were developed and improved.

In the last decades, cherimoya had strong expansion and as already accomplish a considerable commercial importance. The success of this crop is determine by the selection of excellent agronomic and commercial varieties, better technical knowledge, production costs decrease, subtropical geographical localization and ideal climatic conditions of the island.



GEOGRAPHICAL PRODUCTION AREA

Madeira Island is situated 32°38' - 32°52' North and 16°39' - 17°16' West. It's area is 728 km^2, being it's shape almost rectangular, with a maximum length of 58 km (East-West) and 23 km of maximum wide (North-South). From a geological point of view, Madeira Island is basically made of eruptive rocks with a basaltic and pirocalstic constitution. There are several sedimentary formations but not very relevant.

The perceptual distribution of localities with cherimoya orchards is indicated in the following picture.

We can see that Porto Moniz is the locality with the lowest percentage of all, considering that the predominant climatic conditions aren't favorable to this crop.

BOTANY

The cherimoya can grow to small trees 3-10 m tall, with cylindrical trunk with a green gray thick and smooth bark and a superficial branched root system. The branches are very dense, with a tendency to bend themselves, resulting in a leafy three and a fast growth with a globose portage.

This three is considered as being semi-deciduous, because it always remains with leaves. The old leaves fall only occurs when the new bud starts to pressure the old leaves petiole, originating a hollow petiole.

CLIMATE

Madeira island climate is strongly influenced by the orographic conditions. As the north cost is directly exposed to the wind action, the south cost is more protected thanks to the high mountains between those costs, producing an enormous microclimate variety.

From a general point of view, Madeira's climate is mainly temperate with oceanic characteristics, varying from dry to humid and slightly rainy to excessively rainy as we increase altitude. Comparing both cost at the same altitude, climate is always rainier and with low temperatures on the north part of the island. In a generic way, the air annual average temperature decreases from values above 17.5 °C isotermic curve until values around 9 °C on the planaltic regions and high picks on the island's center. The average relative humidity varies from 55% on the low zones to 90% approxirnately in the fog areas. Regarding the total amount of precipitation, there is an obvious increase with altitude, from 500 mm (south cost) to 1000 mm (north cost) at sea level to more than 3200 mm on the higher areas in the interior.

So, these climatic conditions agree with the optimum development and growing conditions to cherimoya crop, that are generally characterized by summer temperatures between 8 and 18 °C and relative humidity between 60 and 80%.

SOIL

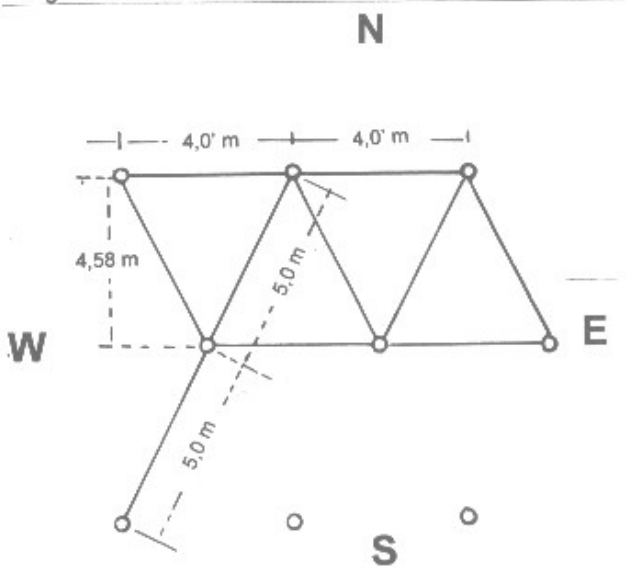
According to Madeira island's soil chart, we can see that the majority of cherimoya plantations are located in soils belonging to "Cambisols (CM)" group, being the "Humic Cambisols (CMu))" and "Chromic Cambisols (CMx))" predominant and, in less extent, the "Phaeozems (PH)" group.

INSTALLING AN ORCHARD

In Madeira Island, the most common distances between plants are 5 x 4 m and 4.5 x 4.5 m, forming a triangle. This plantation system allows a better utilization off the land, what will be appropriate considering the average orchard dimension (1000 m^2).

The orchard can be installed during all year, although it is better during the period from March to May. It is recommended that holes 0.6 x 0.6 x 0.6 m should be open, incorporating organic matter and fertilizers, according the soil analysis previously made.

When installing an orchard, attention should be taken in order that the basis of the plant is placed a little above the soil level, so that no water reach it, promoting the appearance of root diseases, and not forgetting that there will be a small decrease in the plantation level due to organic matter destruction.



The orchard lines should be orientated East-West, considering this particular crop and latitude of the island, allowing a better light use and promoting an increase on plagues and disease resistance, productivity and quality improvement.

PROPAGATION

For many years, the propagation method used was seed, which originated strong plant variability with plants of different genotypes. This variability shows itself on the five botanical types (*impressa*, *loevis*, *tuberculata*, *umbonata* and *mamillata*) and on their fruit quality.

Recently, vegetative propagation by grafting has benefit from the genetic material resultant of the previous propagation method. The first grafting took place 40 years ago, being the top grafting process on one year rootstocks used. This procedure has been abandoned due to a bad scar formation and bad root system development (in the end we have a two-year-old plant in small plastic containers, with consequent problems in the orchard (slow growth and sometimes death). Wanting to overcome this problem the Madeira's Direcção Regional da Agricultura developed (improved) in 1987 a new methodology over the propagation process. So, seeds are placed between December and January in poliethylene bags (diameter 0.2 m and 0.4 high), filled with a mixture with 50% soil, 25% volcanic tuff and 25% organic matter, disinfected with water vapor. After the sowing process, bags are placed inside a greenhouse. After tree or four months the small seedlings reach 0.3 - 0.4 m with 0.003 - 0.004 m diameter. At that time they are side grafted. After grafting, the plants will stay inside that greenhouse two months (six months after sowing), reaching at that time 0.7 m high. Then the small plants are taken to the exterior and placed bellow shading net for 15 days. After that period, the plants are ready to go to the destination place were they can be planted. Comparing to the older method there is a perfect scar formation. Plants develop considerably faster and plants in the nursery or field have better quality, 95% of the plants grafted are produced in the nurseries end the remaining 5% are top grafted directly on rootstocks already plant in the field. In both propagation methods the rootstock used is seed grown cherimoya (*Annona cherimola* Mill.).

VARIETIES

As said before, seed propagation originated plants with different genotypes, reflected by fruit form, type and surface. Forty years ago, "local selections" were carried out by farmers, with grafting techniques, using neighbor plants that produced fruits accepted in the local market, as mother plants. Twelve years ago, the official services initiated the cherimoya clonal and massal selection. A prospection of mother plants during the production period (October-May) was carried out, basing the selection on the direct observation and farmers, trader's phytosanitary brigades information. The plants behavior was observed, their age, origin (obtained by seed or grafted), distance between plants, regularity amount of production, farming practices, plagues and disease more frequent.

During several years (3-4) fruit samples were taken so that a laboratorial analysis could be done, finding qualitative and organoleptic parameters (seeds index, ºBrix, epicarp resistance, taste, texture or hardness, time between harvest and physiological maturing, botanical type). At the same time, genetic material was introduce, from other parts as Spain and United States of America, allowing a variability increase and a comparative adaptability, productivity and quality analysis compared with the local material. The *Annona cherimola* Mill. varieties introduced were 'Pierce', 'Booth', 'Whly', 'Chatee', 'Carter', 'White', 'Cholan', 'Pasicas', 'Spain', 'Campa', 'Bonita Corona', and 'Fino de Jete', and the *Annona cherimola* Mill. x *Annona squamosa* L. varieties 'Pink Mammoth' and 'African Pride'.

The clonal selection is a consequence of the best genotype selection during the first selection stage (mother plants prospection and evaluation). The selected plants (20 - 30) were introduced in fields with the objective of selection the best tree our four cultivars that fit agronomic and commercial requirements. This process originated four improved varieties: 'Madeira', 'Mateus I' (registed varieties on the National Protected Register Varieties Center), 'Perry Vidal' and 'Funchal' (in process of resgitration).

POLLINATION

Madeira Island production is considered very good, considering that the selected varieties are, in a general way, auto-fertile. The climatic conditions that promote self-pollination are temperatures equal or above 22 ºC and relative humidity between 70-80%. These conditions endure the useful life and germination of the pollen. When the temperature is bellow 22 ºC and relative humidity bellow 60% or above 90%, the pollination process is diminished.

The pollination insect presence, as beetles, thrips and ants, helps pollination and fruits development.

On Madeira Island, the fruit development percentage is about 5 - 6%.

FARMING PRACTICES

IRRIGATION

Presently, local irrigation systems are recommended (drip, micro sprinklers and sprinkler irrigation), because of it's water rational utilization and possibility of doing fertilization by the irrigation system, decreasing the cost associated with these two farming practices. The sprinkler irrigation system is recommended for areas where water is not a limiting factor and for sloppy areas (> 16%). The micro-sprinklers systems is recommended for areas where water can be limited and drip irrigation use will occur in areas where water use is very limited.

FERTILIZATION

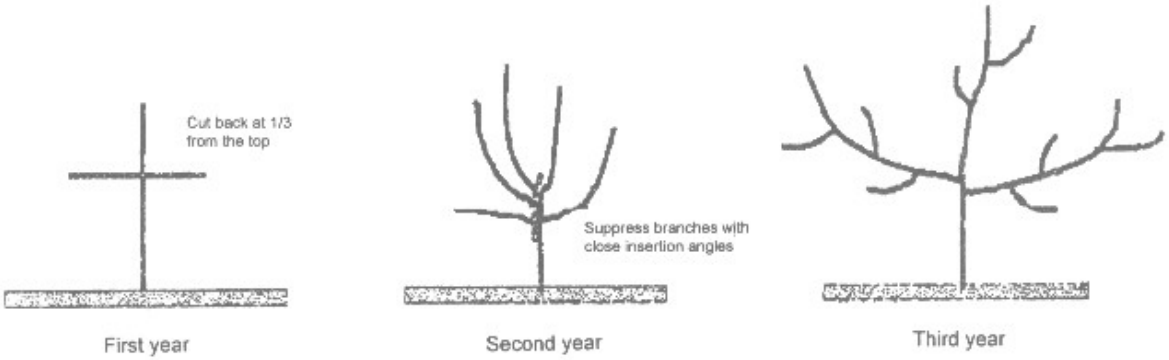
Presently, fertilization has been carried out with good results, according to the soil analysis done by the Laboratório Agrícola da Madeira and with official services technical support. It is important that organic matter is added to the soil, improving productivity and better growth of the plants. At this moment, few preliminary works are in course, aiming to obtain information on the crop nutritional requirements. This tests have great importance, because the date disposal in Madeira are generic and the fertilization systems used in other countries are contradictory.

PRUNING

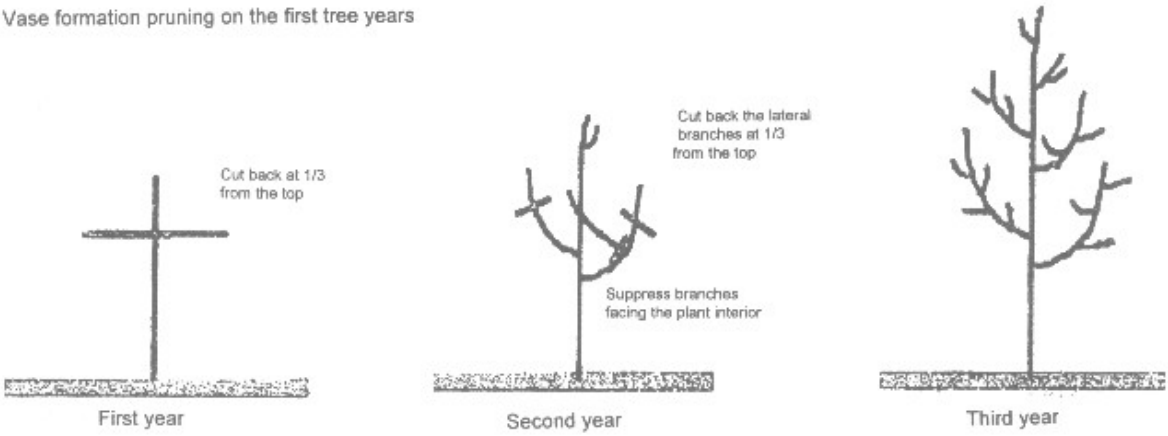
This farming practice is fundamental to the productivity production increase, originating better fruit quality and quantity.

With pruning practices we intend to obtain:

- Build a robust structure at trunk level and main branches
- Improve aeration and better light conditions on the plant interior
- Control the plant high
- Avoid the strong wind effects (fends, broken branches, etc.)
- Minimize phytossanitary problems
- Facilitate harvesting operations, phytosanitary treatments and production cost.



Vase formation pruning on the first tree years



Axis formation pruning on the first tree years.

The pruning period varies as a function of altitude, climatic conditions and variety used. Pruning should be carried out when the leaves drop and yellowing starts (approximately 30 days after fruits harvesting). There are two pruning types: one that is called formation pruning, carried out on threes until 3 years old and other called fructification pruning carried out open threes with four years old.

FORMATION PRUNING

With formation pruning, the young plants natural growth habit of producing very closed angle branches is avoid.

So, the formation pruning allows:

- A good plant formation.
- Correct balance between branch number and their placement on the plant.

It's recommended:

- On the first year (at the beginning of the leave drop) cut the plant at 1/3 of it's high.
- On the second year (also at the beginning of the leave drop) all branches should be eliminated leaving tree our four branches well placed (20-25 cm apart and appropriated angles 60-75º) that will be the main branches of the future plant.
- On the third year (at the beginning of the leave drop), suppress branches that grow to the plant interior so that vegetative balance and aerial structure is maintain.

FRUCTIFICATION PRUNING

It's carried out each one or two years (at the beginning of the leave dropping), starting the fourth year, when the plant starts its production. How to do it?

FIRST STEP

Work the plant interior

- All dry, sick and interior growing branches are eliminated

SECOND STEP

Work from the superior to the base of the plant

- Limit plant high, cutting at the conveñient high (3-4 meters).
- Suppress vegetation that difficult light penetration to the plant interior.
- Suppress growing branches, mainly those that already produced.

THIRD STEP

Work the medium part of the plant

- Suppress shaded branches and that have already produced (branches that have wood pieces of past year fruit).
- Suppress a few branches in the more dense parts of the plant (One year branches are more productive, namely the short ones).
- So, one year branches should not be eliminated, but cut back 1/3 of it's length, as well other branches, so that the flower amount is balanced and an homogenous and better quality is achieved.

REJUVENATION PRUNING

At last, this pruning types applied to old plants in areas well exposed and good soils and that have many dry branches.

The weakest branches are eliminated promoting the appearance of new vegetation with productive potential. Branch girdling can be carried so that new branch formation is stimulated.

The formation pruning can be divided in two types: axis pruning or vase pruning. With these methods a good three structure is obtained that will allow a good loading capacity three.

AGRICULTURE MODERNIZATION AND DEVELOPMENT PROGRAMS

The are several community and regional financial supporting programs that stimulate agriculture development and modernization, such as:

- Regulation CE 950/97.
- Regulation CE 951/97.
- Rural and Agricultural Development Plan (PDAR).
- Finance protocol between a bank (Caixa Geral de Depósitos) and Farmers Associations, Farmers Cooperatives and others organizations.

These programs are allowing Madeira's farming modernization, new production systems and technology more adapted to our conditions, so that this sector normal difficulties can be faced.

PLAGUES AND DISEASES

The cherimoya is considered to be a rustic fruit three, that is, plague and disease resistant, when compared with fruit trees.

The most important cherimoya plague is *Ceratitis capitata* Wied. The larvae are born and develop normally near the seeds or the receptacle axis. If the fruit is attacked when growing, the larvae don't grow because at that time the fruit is to young and doesn't offer them good growing conditions. When the fruits are attacked near to commercial maturing, several transformations occur, namely darkening and decomposition of the pulp.

The cherimoya is attacked by other plagues and diseases mentioned on the table bellow, where the active substances are mentioned in order to control them.

Plagues	**Active substances**
Ceratitis capitata Wied.	Triclorfão + endomosyl, diazinão + endomosyl
Parasaissetia nigra *Saissetia coffeae* *Planococcus citri* *Pseudococcus longispinus*	Mineral oil, metidatião.
Aphis gossypii *Myzus persicae* *Oxoptera aurantii*	Mineral oil + soap, esfenvarelato, pirimicarbe
Diseases	**Active substances**
Colletotrichum gloeosporioides	Dodina, mancozebe, neutralized coper sulfate
Glomerela cingulata *Armillaria mellea*	Tiabendazol, carbendazime
Conservation diseases *Colletotrichum gloeosporioides* *Fusarium* sp. *Phomopsis* sp. *Rhizopus* sp.	Imasalil

Concerning Mediterranean fly (*Ceratitis capitata* Wied), ferohormones traps (ammonium phosphate + vinegar), in order to capture female flies. More recently, it's being implanted in Madeira Island an autocide fighting program for which the Direcção Regional da Agricultura is responsible. This program consists on the male sterile "production" that will be release by air. These sterile males when competing with the normal males, will accomplish a decrease on the fly population levels, with will no longer affect the local fruit production.

HARVEST

Cherimoya should be harvest in the commercial maturation state. Harvest is initiated in October until July, being January to June the best period in with occurs cherimoya exportation. As the production is delayed in time, harvesting is carried out 4-5 times each tree.

After harvesting, cherimoya should be less handled as possible, being carefully placed in 20 kg plastic boxes with filling material below them in order to avoid damage. Fruits should not be exposed to direct sun light, so that sun burn is avoided that would depreciate their commercial value and originate post-harvest problems. Fruits are transported on the same boxes from the farm to the warehouses of expedition, were calibration and classification takes place. This operation is carried out in continuos line by properly qualified personnel equipped with gloves, so that direct contact and fruit mishandle can take place.

CONSERVATION

Harvesting is the main point in cherimoya conservation, as bad handling can promote fungi appearance and/or fruit rotting. The period between harvesting and refrigerating should be as short as possible. Packed fruits are refrigerated at 8 °C with 90 % relative humidity during 12 days, still having four useful days after leaving refrigerating.

UTILIZATION

Besides fresh fruits, cherimoya is largely used in the regional kitchen and industry, as cakes, puddings, ice cream, milkshake, jam, concentrated juice and liqueur.

CO-OPERATION PROTOCOLS PRESENTLY IN WORK OR STARTING IN THE SHORT TERM

Cherimoya massal and clonal selection works in Madeira Island is included in a global *Annona cherimola* Mill. Selection project, in with participate, besides Madeira and Spain, the main cherimoya production South American countries (Chile and Peru). Besides this project, genetic material and scientific exchanges take place between countries like Italy, Cyprus, Turkey,

Israel, Australia, EUA and the referred above ones. More recently, a co-operation program was establish between the Direcção Regional da Agricultura and the Institute do Frio (Madrid) on the cherimoya conservation at low temperatures. Considering that post harvesting conservation is one of the most important problems, this co-operation protocol has an enormous importance to a easier commercialization and increase in the fruit commercial life.

MARKETS

Presently, there is a farmers cooperative, Agriperola, that works with cherimoya expedition and exportation. It's main destinations are the Portuguese mainland, England and more recently France. Though Madeira has in the continental market the major cherimoya producer, Spain, there are proves that there is a market for Madeira's cherimoya, because Madeira's production period does not overlap the Spanish period. It's a product with it's unique organoleptic characteristics as a result of the excellent climatic conditions of Madeira Island. Though more expensive that other cherimoyas, Madeira's fruit is preferred by Portuguese consumers, and an increase in demand for Madeira's cherimoya can be observed.

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