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CHERLA

Promotion of Sustainable Cherimoya Production Systems in Latin America through the Characterisation, Conservation and Use of Local Germplasm Diversity

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| RE | Restricted to a group specified by the consortium (including the Commission Services) | |
| CO | Confidential, only for members of the consortium (including the Commission Services) | |

SUMMARY

All the experiences developed during 2006-2008 in different farmer communities of Southern Ecuador and Northern Peru, all of them involved in the project "Promotion of Sustainable Cherimoya Production Systems in Latin America through the Characterisation, Conservation and Use of Local Germplasm Diversity" (CHERLA), are included in this guide. These communities belonged to "PROCAFEQ" (Association of Highland Coffee Producers from Espíndola and Quilanga) and Playas and Catamayo Rivers Upper Basin Management Committee (Loja) in Ecuador, and Cuyas-Cuchayo Fruits Growers Association (Ayabaca) in Peru.

The main goals of this report are: i) to encourage Southern Ecuador and Northern Peru farmers to grow cherimoya, and ii) to provide an understandable publication to farmers, for them to use it as a guide for the management of this crop.

INTRODUCTION

The Andean region, which comprises the Southern Ecuador and the Northern Peru, is probably the region where the highest diversity of cherimoya occurs. Diversity can be so high that sometimes all cherimoyas types can be found within a single orchard. However, this has never turned into an advantage over other cherimoya producer countries, such as Peru, Chile, Spain or USA. In order to profit from the richness that is present in our area, different local institutions, most of them supported with foreign funds, have been promoting studies to improve the management of the cherimoya production systems in this area for the last ten years. The Cherla project, financed by the European Union, has joined, in the one hand, several public and private institutions in Europe and Latin America, and in the other hand, farmers in Espindola, Paltas and Ayabaca. With the work carried out within the Cherla project it has been successfully proven that cherimoya cropping can be profitable and may become, in the short-time, one of the best economic activities for small and medium-scale growers of this area.

After several lab and field trials, the set of techniques that gave the best results are the ones recommended for each crop management item. These are the following:

SOWING

Once seeds are taken out from healthy ripen fruits, the empty seeds must be discarded. Seeds must be thoroughly washed with water and allowed to dry in the shade for, at least, five days. Seeds must be kept inside paper bags in a dry place if they are not going to be



used immediately.



For sowing, a 3:1 mix of sand and native soil or compost must be prepared. Before sowing, seeds must be soaked in renewed daily water for 10 days in order to increase germination rate. Sowing can be carried out in seed beds, spaced 5 cm between rows to 2 cm along the row. After 15 days seeds will germinate.

TRANSPLANTS

When sowing is done in seed beds, plants must be transplanted when they reach 10 cm high or have 4 true leaves at least. To do so, plastic bags must be filled with a 2:1:1 mix of soil, sand and compost. To keep roots inside bags, these must be large enough (e.g., 50 cm height x 20 cm diameter).



NURSERY MANAGEMENT

Nursery plants must be trained to one shoot and kept as much erected as possible. To do so, plants can be supported with stakes made of wood, cane or other easily available materials.

Plant growth may be encouraged applying every eight days manure-based organic fertilizers. Plants may be irrigated twice a week.

Plant must grow in a shaded area during the first two months. Tree branches or nets can be used to provide shade. From that time onwards, shading of plants is not necessary (plants can grow in full sunlight).



GRAFTS

Nursery plants are ready to be grafted when stem diameter reaches about 2 cm. Although different grafting methods can be successfully used in cherry tomato nursery plants, that with the best results in our conditions is apical grafting. Scions to be used in grafting must be taken from selected plants regarding yield and fruit quality. Scions from outstanding plants have been used in orchards belonging to farmers of different farmers associations. In these orchards scions for new graftings are available.

For grafting in the field, growers commonly use lateral grafting and apical grafting.

Grafts must be done during the dry season, which occurs between July and September in Southern Ecuador and Northern Peru.

Plants will be ready to be planted in the field when graft union has healed and scion has reached 20 cm long.

Grafted plants ensure growers a high orchard homogeneity, crops with high quality fruits, and an earlier start to produce fruit, i.e. 3 years after transplanting.



PLANTATION IN THE FIELD

Typical hole size for cherimoya planting would be 0.5 x 0.5 x 0.5 m. Tree spacing changes according to cropping type. Tree will be spaced at 8 x 8 m or 10 x 10 m if cherimoya plants are intercropped in coffee, bananas or citrus orchards. Trees will be spaced at 4 x 4 m or 5 x 5 m in cherimoya orchards.

A mixture of native soil and organic amendments can be used to backfill the bottom of the planting holes. Half a bag of compost or aged manure per plant is recommended.



IRRIGATION

Cherimoya plants must be adequately watered during vegetative growth and fruit development to get high yields year by year. Therefore, water management can be critical between August and November in Southern Ecuador and Northern Peru. In this period, irrigate twice a month can be necessary.

YOUNG TREE TRAINING

The main aim of tree training during the first years is to develop a proper framework to get a good basic tree shape. To achieve this, 3 or 4 well-spaced and strong limbs must be selected.

The selected limbs must be pruned to 50 cm in length to reduce vigour and encourage lateral growth.



LARGE TREE TRAINING

Management of large trees in the orchard can be improved by renewing their framework. This can be done in different ways according to tree age and shape.

-Total or drastic pruning

Only recommended in extreme conditions, e.g., trees with a single dominant trunk where canopy is too tall for an

easy tree management.



A cutting a mature tree back to a height of 40-50 cm above ground is recommended.

Subsequent regrowth must be trained as was

described for young trees.

Shoot selection must be done leaving 4 well-spaced branches at the most, that can be grafted with scions from an outstanding variety when they become woody or they reach a diameter of, at least, 1.5 cm. New shoots of pruned trees with good performance are not necessary to be grafted.

Cut back plants will fruit again in two years after pruning.

High or second level pruning

This kind of pruning can be used in trees with limbs too low for a proper management, e.g. at a height between 0.5 and 1.2 m above ground. In this case, limbs must be removed from the trunk up to 1.7 m height, leaving 4 well-spaced branches at the most. Pruned plants will fruit the year after pruning.



Branch bending

Branch bending is usually done in young plants (from 2 to 5 years old) with an excessive vigour that produces a dominant upright growth. To do it properly, branches must be carefully bent downward with a rope or something similar wrapped round tip branch. Once on the ground, tip branches must be tied to another tree or a stake. As described in other types of pruning, only 4 well-spaced and strong branches must be selected to bend and the remaining branches must be removed. Branches must be tied for 1 or 2 months to change branch habit growth and, this way, get smaller plants suitable for a good management from the ground. Plants with bent branches will increase yield without losing the following crop.

FERTILIZATION

Bearing trees remove from the soil great amounts of nutrients that must be apply to replace these losses. To do that, farmers can use different types of fertilisers. In organic production, mixtures of on-farm materials with cheap commercially available fertilisers are commonly used. Ashes, compost, phosphoric rocks, plant residues, humus-rich soil are some of these materials.

A good fertiliser for cherimoya can be prepared by mixing 2 bags of compost or humus-rich soil, 5 kg of phosphoric rock and half a bag of ashes. This mixture must be applied to the soil, inside a



trench around the tree. In steep hillside orchards, fertilisers can be placed along a half-moon shaped trench opened on the upper side of the slope around each tree or evenly divided among 4 holes opened at the 4 corners of the square around each tree. 2.5 kg of fertiliser per tree must be applied at least. Yearly fertiliser application rate must be adjusted to tree size and, therefore, it must be increased as tree grows up.



MANUAL POLLINATION

Historically, fruit set in cherimoya has been mainly relying on natural pollination success. Insects are the main pollinating agents in cherimoya natural pollination.



As poor natural pollination has occurred for the last years, identification of the main insect species involved in cherimoya pollination was done in different surveys carried out in this area. From these surveys it was clear that herbicides, insecticides and fungicides sprayings were behind pollinators agents populations decrease.

In this background of poor natural pollination, hand pollination is a promising tool to get high yields in cherimoya. Hand-pollination is a tedious but easy to do and profitable technique. To hand-pollinate properly, it is first necessary to learn how to identify the three cherimoya flower stages: the pre-female stage, the female stage and the male stage.



- *The pre-female stage*

This is the first step of the flower opening process. At this stage, the petals have opened slightly apart at their tips in the morning or around noon. In the evening of the same day, flowers that will be at the female stage by the morning of the next day can be clearly identified. Flowers

that are in the pre-female stage can be pollinated and are ready for collection to extract pollen.



- *The female stage*



At the female stage, flowers are half-open (the petals open to 45°), but the female parts cannot be easily seen. Flowers in the female stage can be hand-pollinated and are still ready to be collected to extract pollen. Most flowers can open to the female stage from 7.00 a.m. to 1.00 pm.

- *The male stage*

Flowers in the male stage are clearly identified in the field as they are full-open (the petals open almost to 90°) and they produce nice scents. At the male stage the inner parts of the flower can be easily seen and stigmas are surrounded by a yellow circle of anthers ready to release pollen. Shift from the female stage to the male stage mainly happens in the afternoon (it usually occurs around 1.00 p.m.), although cherimoya flowering behaviour can be affected by climatic conditions. Flowers in the male stage have been seldom found in the morning.

Collecting flowers to extract pollen

Flowers are suitable for collection both in the pre-female stage and in the early female stage (e.g., in the morning of the first day of a 2-day cycle). Flowers in the female stage must be pollinated in the afternoon of the first day or in the morning of the second day of a 2-day cycle. Place the flowers in a well-ventilated net bag. Do not use bad-ventilated containers (plastic bags, etc.) to store flowers. Do not store flowers in layers higher than 5 cm to avoid flower fermentations. Keep flowers in thin layers within a cool and well-ventilated room for 4-5 hours. In orchards with very few cherimoya plants, flowers to extract pollen can be collected from trees outside the orchards in order to leave on bearing trees as many flowers to be pollinated as possible.



Pollen extraction

For pollen extraction collected flowers must be hanged according to flower stage:

- Flowers in the pre-female stage (pollen from flowers that will not shift to the male stage)

Pull the petals off the flowers, and then place the flowers on a 2-3 mm meshed sieve and remove the stamens by shaking the flowers over the sieve net. Keep the pollen at room temperature if it is going to be used during the same day of extraction or in the morning of the next day. Keep the pollen in the refrigerator (at 3-7 °C) if it is going to be used starting two days after extraction.

- Flowers in the female stage (pollen from flowers that will shift to the male stage)

Place the flowers on a 2-3 mm meshed sieve and remove the stamens and the pollen by lightly pressing the flowers by hand. Avoid beating the petals and the stamens since part of the pollen could remain on the hairs of the outer side of petals. Stamens and pollen must be collected on a clean and smooth surface.

Store the pollen and the stamens in a wide and well-ventilated container (ie. a plate) so that they are spread out as a shallow layer. Keep the pollen and the stamens into the lower part of the refrigerator (at 3-7 °C). The pollen must be used in the afternoon of the same day of extraction or in the morning of the next day. Place the pollen in the refrigerator after extraction as soon as possible if it is not going to be use in the same day.

In orchards with very few cherimoya plants, flowers to extract pollen can be collected from trees outside the orchards in order to leave on bearing trees as many flowers to be pollinated as possible. Do not take flowers from diseased, chlorotic or low vigour plants.

Pollinating flowers

Manual pollination must be done in the morning, best from 7.00 to 12.00, since most of the flowers in the female stage can be found at this time. Two pollination techniques are usually used: the hairbrush method and using a puffer gun. Choose one of them depends on tools availability and price. Hairbrushes are widely used as they are easily available and cheap.

In the field, pollen must be stored in closed glass jars and kept in the shade and, if possible, inside a portable refrigerator in order to keep pollen viability as long as possible.

Both hands are used together for an easy and quick hand-pollination. With the brush method, pollen must be stored in a container hung around the neck so that one hand can hold the flower to be pollinated and the other can move the brush. Using a puffer gun, one hand can hold the gun, always upright to discharge properly, and the other can hold the flower to be pollinated.



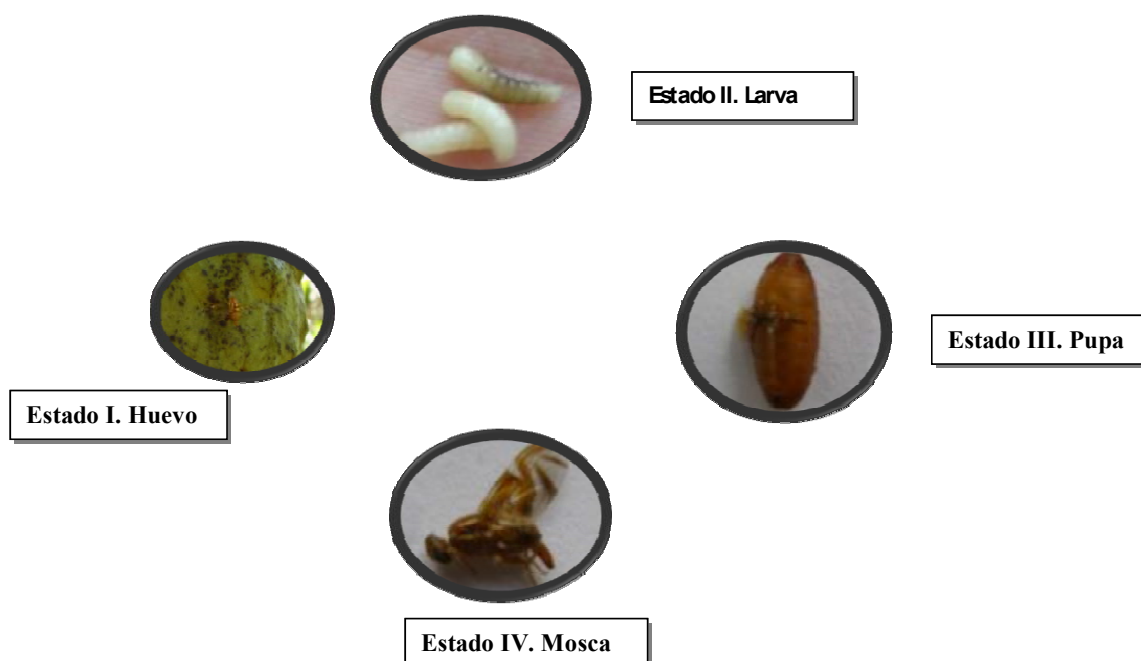
Transfer the pollen from the container to the female parts of the flower is required for pollination. To do it properly, gently separate the petals, and put the brush with pollen inside the flower and turn it so that the pollen remains on the stigmas. If a pollinator gun is used, lead the puffer inside the flower without touching the stigmas and discharge once. In both methods an even distribution of pollen on the carpel body of the flower is required to produce fruits with good shape. Pollinated flowers can be marked cutting a piece of a petal.

FRUIT FLY CONTROL

The most important pest of cherimoyas is the fruit fly. This pest is very well adapted to the environmental conditions where cherimoya grows. With time, the population of fruit flies have increased enormously, reaching levels wherein more than 50 % of fruits have been found infested.

Fruit flies undergo 4 stages during their development. The first stage is the **egg**. Females inject from 1 to 8 eggs to the fruits with their ovipositor. After 3 or 4 days, the eggs hatched and the second stage, **larvae**, will start feeding on the pulp of fruits. After c.a. 10 days, larvae go out of the fruits and search for the soil, and at 2-3 cm deep in the soil, they will change to the third stage, **pupae**; they remain in this stage for 23-25 days, until emerging as **adults**, the fourth and last stage. Then, the adult seeks for food and starts its reproduction. A female can lay 700 to 800 eggs during her lifetime. The worst is that it only deposits 1 to 8 eggs per fruit. However, a fruit can have several punctures from different females.

There are stages wherein the control can be more efficient. At the egg stage it is impossible to control, because they are imperceptible under the fruit. Control, has to be centred on the larval and adult stage.



- Burial of fruits: When the crop is at the last phase, and we observe fruits that are punctured in the soil or in the tree, we will know that those fruits are infested by the fruit fly. Then, we have to collect all those fruits and bury them, or give them to farm animals; by doing so, we are impeding the proliferation of the pest. To bury the fruits, the hole has to be 30 deep at least. We can also put fruits inside plastic bags exposed to the sun. Heat will kill the larvae, and with this the expansion will be avoided. After that, we can use the contents of the bags as organic compost.



- Selection of fruit trees in the property: The species of fruit trees to have in the property must be chosen. Many times we have species that we never use (guaba, almond, guayaba). Those species must be pruned and their numbers reduced. The idea of doing so is to decrease the number of potential hosts for the fruit flies that might help to break its yearly biological cycle. On the contrary, if we decide to keep those species then we have to base our strategy on methods that will impede its dispersion to the cherimoya.

- Packing fruits to protect them: Cherimoya fruits destined for commercialization must be packed inside bags one to one. The material to be used can be fabric, paper or plastic; by doing so we will avoid egg laying by fruit flies. Packing must be done when the size of fruits is that of a lemon, or a month and a half before fruits reach the final size.



- Raking of the soil around plants: When the season is over, it is recommended to rake the soil around plants, and mix the surface of the soil (5 cm deep) all over the area projected by the shadow of the tree to the soil. By doing so we will kill most of the pupae that otherwise would become adults.



If you carry out all these activities you will note that the following year the amount of fruit flies will have decreased, and consequently, you will get more healthy fruits.