

Potential of cherimoya (*Annona cherimola* Mill.) in southern Ecuador

Potencial de chirimoya (*Annona cherimola* Mill.) en el sur del Ecuador

Xavier Scheldeman¹, José Vicente Ureña Alvarez², Veerle Van Damme^{3*}, Patrick Van Damme⁴

¹Ghent University, Coupure links 653, B-9000 Ghent, BELGIUM, e-mail: xavier.scheldeman@rug.ac.be (Corresponding author)

²Centro Andino de Tecnología Rural, Universidad Nacional de Loja, Casilla 399, Loja, e-mail: ECUADOR, agrcater@impsat.net.ec

³Agricultural Research Centre (CLO), Burg. Van Gansberghelaan 96, B-9820 Merelbeke, BELGIUM, e-mail: v.vandamme@clo.fgov.be

⁴Ghent University, Coupure links 653, B-9000 Ghent, BELGIUM, e-mail: patrick.vandamme@rug.ac.be

*Affiliation during research period: Ghent University, Coupure links 653, B-9000 Ghent, BELGIUM

Abstract

Loja Province (southern Ecuador) is generally acknowledged to be located in the centre of origin of cherimoya (*Annona cherimola* Mill.), a promising Andean fruit that is cultivated on an increasing scale, with Spain, Chile and United States showing growing interest in its commercialisation. A global study of cherimoya in Loja Province realised from January 1996 till September 1999 gave valuable information for future crop development. Although cherimoya is very common, well known and appreciated all over the province, commercial cultivation has not yet developed and the trees are found in the wild or tolerated in farmers' gardens. Loja Province will be able to exploit its big potential for commercial cherimoya cultivation if and when the possibilities linked to the presence of wild cherimoya trees will be optimally used and the difficulties are resolved.

The potential lies with (i) optimal edaphoclimatological conditions for cherimoya cultivation (shown by the presence of wild cherimoya trees), (ii) a lot of pomological potential, due to the big variability, with the presence of some excellent accessions, (iii) presence of natural pollination, eliminating one of the factors that complicates commercial cherimoya cultivation elsewhere, and (iv) an excellent acceptance and appreciation by local consumers, ensuring a good market. The difficulties and problems to be solved are (i) the presence of native pests and diseases especially fruit fly (*Anastrepha* spp.), resulting in heavily infested harvests, (ii) generative propagation resulting in a very heterogeneous harvest of mediocre quality, (iii) lack of cultural practices as land preparation, use of fertilizers, irrigation, tree formation, etc. resulting in low and irregular annual yields, and (iv) lack of an adequate fruit transport system from faraway harvest points to points of sale resulting in damaged fruits. These problems, although relatively easy to resolve, result in low quality fruits and low prices leading to a lack of interest of local agrobusiness and the evident risk of loss of genetic diversity.

Resumen

La Provincia de Loja (sur del Ecuador) es reconocido estar localizado en el centro de origen de la chirimoya (*Annona cherimola* Mill.), uno de los frutales andinos promisorios que se cultiva en una escala creciente, con España, Chile y los Estados Unidos mostrando un interés aumentando en su comercialización. Un estudio global de chirimoya en la Provincia de Loja, ejecutado desde enero 1996 hasta septiembre 1999, dio información valiosa para un desarrollo potencial del cultivo. Aunque la chirimoya es muy común, conocida y apreciada en toda la provincia, el

cultivo al nivel comercial no se ha desarrollado todavía y la mayoría de los árboles se encuentra en estado silvestre o está tolerada en los huertos de campesinos.

Sin embargo la Provincia Loja tiene mucho potencial para un cultivo comercial de chirimoya si se logra aprovechar las posibilidades ligadas con la presencia de árboles silvestres y resolver las dificultades actuales.

Estas posibilidades son: (i) las condiciones edafoclimatológicas óptimas para el cultivo de chirimoya (aprobado por la presencia de árboles silvestres), (ii) el potencial grande en características pomológicas, debido a la gran variabilidad, con algunas accesiones con calidades excelentes, (iii) la presencia de polinización natural, eliminando uno de los factores que puedan restringir el cultivo comercial de la chirimoya, y (iv) la apreciación muy grande de los consumidores locales, resultando en un mercado seguro. Las dificultades y los problemas a resolver son: (i) la presencia de plagas y enfermedades nativas, sobre todo la mosca de la fruta (*Anastrepha* spp.), resultando en una producción muy infestada, (ii) la propagación por semilla resultando en una cosecha muy heterogénea de calidad intermedia, (iii) la falta de aplicación de prácticas culturales como la preparación del terreno, el uso de fertilizantes, poda de formación, riego, etc. resultando en cosechas anuales irregulares, y (iv) la falta de un sistema adecuado de transportación de los frutos desde lugares alejados hasta puntos de venta resultando en frutos dañados. Estos problemas, aunque relativamente fáciles de resolver, resultan en frutos de mala calidad y precios muy bajos, los cuales resultan a su vez en una falta de interés de inversionistas y el riesgo de pérdida de la diversidad.

Introduction

Although there is still no definitive agreement about the exact location of the centre of origin of the cherimoya (*Annona cherimola* Mill.), there is little doubt that Loja province is situated in an important centre of biodiversity of this Andean fruit species. Most early chroniclers agree about the Andean region and more specifically the Loja region as being the centre of origin of cherimoya. Popenoe (1921) presented it as being native to the valley of Loja where it grows in the wild forming dense forest stands. Guzman (1951) stated that cherimoya probably originates from the inter-Andean slopes of the Marañón river basin, covering north Peru and south Ecuador, at elevations ranging 1,500 – 2,200 m above sea level (masl). Most authors consider the temperate, dry inter-Andean valleys of southern Ecuador and northern Peru as being the centre of origin of cherimoya (George et al. 1987, National Research Council 1989, Sanewski 1991).

Since indigenous people spread cherimoya seeds over most of Latin America and Spanish explorers took cherimoya seeds to Spain, cherimoya can be found in most subtropical areas worldwide. In the New World, the biggest concentrations can be found in Chile (Gardiazabal & Rosenberg 1993), United States (Grossberger 1999), Mexico (Augustin 1999), Peru (Franciosi Tijero 1992), Bolivia and Brazil (Bonaventure 1999). Worldwide Spain is currently the biggest cherimoya grower with 3,400 ha (Farré Massip et al. 1999), with smaller plantations in other Mediterranean countries, Australia (Sanewski 1991), New Zealand (Richardson & Anderson 1993), South Africa (Du Preez 1996) and South East Asia. Although still a relatively unknown fruit in the international tropical fruit market, worldwide cherimoya cultivation is increasing.

From the beginning, farmers and later scientists started a steady process of selecting the best fruits. Combination of these selection efforts and the fact that most cherimoya plantations use grafted trees resulted in the establishment of cultivars with more or less fixed properties. Some of the most widely cultivated cultivars are 'Fino de Jete' which occupies 95 % of the Spanish cherimoya area (Farré Massip & Hermoso González 1997), 'Bays', 'Booth' and 'White' in the United States and Australia (George et al. 1987), 'Reretai' and 'Bronceada' in New Zealand (Richardson & Anderson 1993), 'Bronceada' and 'Concha Lisa' in Chile (Gardiazabal & Rosenberg 1993) and "Cumbe" in Peru (Franciosi Tijero 1992).

A typical cropping feature of plants and/or crops in or near their centre of diversity, is that they often display a big variability in characteristics that can be used in any kind of breeding programme. This is also true for cherimoya. In Ecuador, cherimoya plants often grow in the wild or are propagated by seeds so that no real cultivars are found here and fruits do not contribute significantly to a rise in income for a majority of the local farmers.

Cultivation potential

SUITABLE EDAPHOCLIMATOLOGICAL CONDITIONS

As cherimoya grows in wild stands in Loja Province, an edaphoclimatological study of a number of locations can give valuable indications of the requirements in soil and climatic conditions of cherimoya trees. A total of 20 sites with abundant presence of cherimoya forests were selected and soil and climate at these locations were examined (Bydekerke et al. 1999). The sites studied were all located between 1,550 and 1,900 masl. At lower and higher elevations, cherimoya trees can still be found, although in much smaller quantities, and in dispersed stands. Mean annual temperatures at these sites vary between 18 and 21 °C, while minimum temperatures vary between 10 and 12 °C, and maximum values between 26.5 and 30 °C, respectively. Annual precipitation ranges from 650 to 1,250 mm. There is a high proportion of the total territory of Loja Province with similar precipitation values but without wild cherimoya stands, which would suggest that precipitation is less limiting than temperature (altitude) for cherimoya to occur. Recalculated textures for the sampling points show that soils with relative high sand content predominate. The most frequent textures are sandy loam, loam and sandy clay loam. Most soils were shown to be slightly acidic with pH between 5 and 6.5. Organic matter content is moderate with values ranging from 1 to 5 %, and an average value of 3.6 %.

These edaphoclimatological requirements, combined with climatological and soil maps, can yield a zonal classification of Loja Province giving optimal zones for cherimoya cultivation, a useful guide to define where cherimoya could be cultivated. Using an adaptation of the “simple limitation method” (Sys et al. 1991) and by means of GIS suitability maps can be generated (Bydekerke et al. 1998). A total of 8.7 %, or 970 km², of Loja Province is thus considered as well suited. Loja Province offers sufficient areas where climate and soil conditions are well-suited, to develop commercial cherimoya cultivation.

OUTSTANDING POMOLOGICAL CHARACTERISTICS

During germplasm collection, a total of 448 fruits, representing 137 trees were sampled on 32 sites throughout the province. Fruits were characterized (Scheldeman et al. 1999) in order to obtain information on existing variability and to select the best accessions for future breeding research. Based on the most important pomological characteristics, as seed index (number of seeds per 100 g fruit) and fruit weight, a number of promising accessions were selected.

Comparing these characteristics with some commercial cultivars of cherimoya exporting countries (Scheldeman & Van Damme 1999) it is clear that, due to the big variability, Loja Province possess some excellent accessions (Fig. 1 & 2). Unfortunately these accessions have not been utilized and can be found in the wild or tolerated in a farmers’ garden among several accessions without suitable characteristics.



Figure 1 - Comparison of seed indices of local selected accessions and commercial cultivars



Figure 2 - Comparison of fruit weight of local selected accessions and commercial cultivars

PRESENCE OF NATURAL POLLINATION

In most cherimoya exporting countries as Spain (Lopez & Martínez 1987, Farré Massip et al. 1999), Chile (Gardiazabal & Rosenberg 1993, Gardiazabal & Cano 1999), United States (Schroeder 1941, Grossberger 1999), Australia (George et al. 1989, Sanewski 1991) and New Zealand (Richardson & Anderson 1990) artificial pollination is necessary to obtain good homogeneous yields. This artificial hand pollination is labour-intensive increasing considerably production costs.

Natural pollination occurs through insects (Coleoptera, Hemiptera) with fruit set percentages between 0.5 and 5 % (Richardson & Anderson 1990) being reported. Techniques to improve pollination, by increasing insect populations are still in an initial phase (George et al. 1992, Gardiazabal & Rosenberg 1993, Farré Massip et al. 1999). Although in Loja Province no artificial pollination is used, trees yield considerable amounts of well-formed fruits. A preliminary study on natural pollination in Loja Province showed a fruit set of 29.9 %. Although no studies on pollination agents have been realized yet, it is probable, taking into account the large population of wild cherimoya trees, that sufficiently large populations of pollinating insects are present to obtain adequate natural pollination. Natural pollination has also been observed in northern Peru (Franciosi Tijero 1992). As in Loja Province natural cherimoya pollination is present, a considerable amount of labour, and production costs, can be reduced.

EXCELLENT MARKET CONDITIONS

To have an idea about the local acceptance of cherimoya fruits and fruit products, a survey was realized on the market in the city of Loja. A total of 100 interviewees were polled about their cherimoya consumption habits and preferences. The survey showed that 96 % of interviewees regularly consumes fruits during cherimoya season (Jan. – June). An average family consumes 5 – 8 fruits weekly, although this amount decreases during the season due to decreasing fruit sanity and thus fruit quality. The first buying criterion is sanity, especially absence of fruit fly (*Anastrepha* spp.).

Fruits are sold by local farmers to a middleman at 4-5 US\$/100 fruits. This middleman sells to retailers for 7.5 US\$, who sell the fruits to consumers for 0.25 US\$ per fruit (25 US\$/100 fruits). It is obvious that retailers get most of the gains, nevertheless they are also the ones that suffer the losses, up to 50 %, mainly due to sanitary problems (fruit fly) and short shelf life.

It is obvious that cherimoya commercialisation in Loja Province does not show any problems at consumer level, who are well familiarized with the fruit. Considerable problems, however, lie at the commercialisation level, at farmers' level, where low fruit prices do not incite the use of adequate production systems. Moreover, phytosanitary problems lead to big losses at retailer level.

Cultivation difficulties

PRESENCE OF NATIVE PESTS AND DISEASES

Due to the present of cherimoya forests, where no phytosanitary treatments are used, phytosanitary problems associated with cherimoya can proliferate. A study of the most important pest and diseases was carried out in Loja Province. At tree level the most important pest was the leaf miner (*Phyllocnistis* sp.) while a leaf spot, caused by the fungal complex of *Fusarium* sp., *Cladosporium* sp., *Phomopsis* sp. and *Centrospora* sp., was the most important disease. At fruit level, the fruit fly, *Anastrepha* spp., is the most important disease and a sclerosis, identified as *Cladosporium* sp., is the most important disease.

When surveyed for the most important phytosanitary problems, 94 % of the farmers indicated the fruit fly as their most important problem, adding that the problem is worsening year by year. Although no detailed studies exist, deforestation and the replacement with fruit trees as ice-cream bean (*Inga* sp.) and guava (*Psidium guajava* L.), lead to fruit production throughout the year maintaining the fruit fly population and complicating its control. Characterization of the germplasm collection revealed that 59 of the 137 accessions (43 %) were infested with fruit fly.

Phytosanitary problems, especially fruit fly (*Anastrepha* spp.), result in an infested harvest, and are one of the main limiting factors in the development of cherimoya cultivation. The huge losses involved make this cultivation uneconomic and unattractive.

GENERATIVE PROPAGATION

In a survey on cherimoya propagation, 84 % of the farmers reported not to have sown their cherimoya trees, while 16 % actively sow cherimoya seed. None of the farmers possessed grafted trees. Most trees can be found tolerated in the farmers' field where they are not sown, but once germinated from seeds of eaten or fallen fruits, protected by the farmer. This propagation system, typical for native plants, leads to very heterogeneous trees often resulting in poor harvests of intermediate quality. Characterization results of 137 accessions show indeed a very big variability at pomological level, often resulting in fruits of inferior quality. (Fig. 3 & 4).

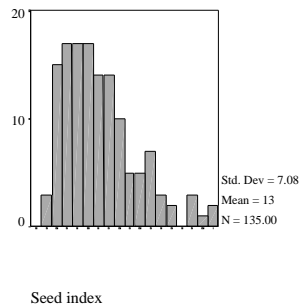


Figure 3 - Histogramme and statistics of seed indices for collected accessions

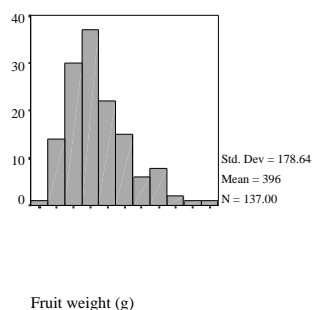


Figure 4 - Histogramme and statistics of fruit weight for collected accessions

Although Loja Province possesses promising cherimoya germplasm, as shown before, a lack of seed selection or, ideally grafting, leads to very variable harvest quality. The heterogeneity and sometimes bad quality, e.g. due to high seed content, results in an underestimation of local cherimoya quality.

LACK OF CULTURAL PRACTICES

Results of a survey on cherimoya cultivation in Loja Province show that farmers do not only not actively plant cherimoya, but moreover they rarely use other agricultural practices to improve production.

Only 14.2 % of the surveyed farmers applies fertilization, 3.7 % uses chemical fertilization against 10.5 % organic fertilization. Application of herbicides or pesticides is absent, although most farmers indicate fruit fly as a major problem. A total of 34.6 % of farmers report they prune their trees, although pruning is seldom aimed at formation or fructification, as it targets elimination of old or abundant branches (often for firewood). Only irrigation is used commonly (32.7 % of the farmers), mostly as part of a general irrigation scheme of the backyard garden.

Besides giving a heterogeneous harvest of intermediate quality, cherimoya trees provide much lower yields than potentially possible. The lack of fertilization results in yields that are very irregular while the lack in use of phytosanitary products leads to a heavily infested harvest.

LACK OF ADEQUATE TRANSPORTATION SYSTEM

Results of a survey on commercialisation show that 61 % of farmers do sell their fruits. The others do not sell due to lack of adequate yield, or more often because their farms are too isolated and remote. Cherimoya is a delicate fruit that blemishes easily and needs careful handling during transport. Farmers harvest and sell their fruits green, when they reach physiological maturity, but even then fruits remain susceptible to bruises. In most cases (93 %) fruits are packed in plastic bags, a cheap packing material that does not protect fruits adequately. Taking into account the bad condition of secondary roads, especially in the raining season, which coincides with the harvest season, it is clear that fruit quality is also deteriorating due to transportation damage.

Towards commercial Cherimoya cultivation

In order to achieve successful profitable cherimoya cultivation in Loja Province it is necessary to improve the present cultivation system.

Only suited sites must be selected for future cultivation. Selected sites must comply with soil and climate requirements, but must also be located on a manageable distance of market points. Sites that do not meet these criteria cannot be selected as sites where profitable cherimoya cultivation is possible. Trees with excellent pomological characteristics must be selected and multiplied by grafting, in order to obtain a qualitative homogeneous harvest. Genetic characteristics can only reach their maximal expression by using the adequate agricultural practices. The use of irrigation and fertilization is necessary to obtain regular and high yields. Applying formation and fructification pruning avoids an excess of vegetative growth and facilitates plant management. Phytosanitary control, facilitated by pruning, is indispensable to obtain a healthy harvest. Although fruit fly is a serious problem in Loja Province, studies realized in Ecuador show the existence of relatively easy methods, using hydrolysed proteins and dimethoate (León Fuentes 1999), to control this pest. The last step to get these qualitative fruits to the market is to change the packing material from sacks to small wooden boxes.

Obviously, this cultivation system will increase considerably production costs. Nevertheless superior fruit quality will justify a slightly higher price to the consumer. Moreover, absence of post harvest losses, following phytosanitary treatment, will decrease losses at retailer level and eliminate the necessity for big gain margins to compensate these losses.

Acknowledgements

The authors wish to thank the Flemish Interuniversity Council (VIIR, budget 130D0194), the Flemish Association for Development and Technical Assistance (VVOB) and the Directorate General of International Cooperation (DGIS) for financing the research project “*Conocimientos y Prácticas Culturales sobre los Recursos Fitogenéticos Nativos en el Austro Ecuatoriano*” (1995-2000), and the Special Research Fund (BOF) of Ghent University for giving the possibilities to continue the research (2000-2002).

The research was only made possible with the help of the scientists of the “Centro Andino de Tecnología Rural” (CATER) of the National University of Loja. Finally, a lot of thanks to the farmers of Southern Ecuador for their continuous help during the research.

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