YELLOW PITAYA (SELENICEREUS MEGALANTHUS) PRODUCTION SYSTEM IN BOYACÁ – COLOMBIA

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ABSTRAC

The pitaya is a promising fruit for Colombia and the department of Boyacá, considered as one of the important fruits for the export market. Statistics show that the department of Boyacá is the largest producer of yellow pitaya (*Selenicereus megalanthus*). In Colombia. this fruit has been prioritized in policies and programs at the national and local level, among other reasons because it shows potential for the export market. However, the low technological development of crops has been one of the factors limiting the productivity and quality of the fruit, so its production has so far been for unprofitable markets. No technological problems have been identified, nor action taken to bring national and global technological support in order to address these issues. The aim of this study was to establish the state of technology in the production chain in the cultivation of yellow pitaya at each stage of production and marketing. The methodology that was used was qualitative-descriptive based on field visits, interviews and surveys of pitaya fruit growers in the municipalities that were reported as producers. Within the results, the state of technology was identified in the productive chain of yellow pitaya, which has been empirically cultured. This is certainly a species with great potential, for example for its use in agribusiness, and therefore strategies should be considered that support their producers in order to improve profitability.

Keywords: *promising crops, exotic fruit, cropping system, crop management*

In Colombia the pitaya is a key product in the economic lines of fruit for its adaptability to different environmental conditions (ICA, 2012) and for being a fruit considered promising in the country and in the department of Boyacá, being among the most interesting for the export market with potential identified at the regional, national and international levels (MADR, 2006).

Colombia is the largest producer of yellow pitaya worldwide (FAO, 2009) and one of the most important problems is the lack of studies based on scientific research, that enable support and / or improvement to the agronomic practices that producers are developing based on their own experiences (Medina *et al.*,2011). Boyacá department is the largest producer nationwide. Despite being the largest producer of yellow pitaya and based on statistics from Agronet (2011), it can be observed that the Boyacá department has the second lowest productivity in the country (7.5 ton • ha-1) and is below world average, which is 8.04 t • ha -1 (Betancourt *et al.*, 2010).

Its cultivation was implemented on a commercial basis by the National Federation of Coffee Growers in the program of diversification in the early eighties (Delgado, 2010) . Due to inexperience in cultivation, a series of errors were committed such as farming outside the optimal agro-climatic strip, plant health type problems, and a lack of integrated management with consequences on productivity and fruit quality. Added to this, the producers and marketers stumbled onto a domestic market that was unable to absorb the supply of pitaya (MADR, 2005). At the end of the decade the sector had faced various problems in production because the producers did not have a proper cultivation technology package and did not generate the expected return (ICA, 2012).

Pitaya is commercially classified into seven grades, and of these over 50% of production in Boyacá is based on the 4 lowest grades. The price of the latter is less than 20% of the value of the type of fruit for export (CREPIB quality, 2011).

As the largest producer of yellow pitaya nationally, the Boyacá department should develop strategies to promote its cultivation in a technological manner in order to position itself as having the highest quality fruit and to develop a program of Research and Technological Development for closing technological gaps in the production chain.

In the department of Boyacá, its cultivation is concentrated in the hands of small producers, who have developed their own culture technologies and although some of these practices are not the most appropriate, conversion into high modernization may not be the best solution. This investigation was part of the "construction technology plan for the productive chain of the yellow pitahaya (*Selenicereus megalanthus*) in the department of Boyaca" project, developed by the research group GIPSO from the Pedagogical and Technological University of Colombia. Its aim is to build in a participatory manner the "Technological Plan for the Productive Chain of yellow Pitahaya (*Selenicereus megalanthus*) in the Department of Boyacá". In order to do this this a characterization and technological inventory of the production chain of yellow pitaya was done in the department Boyacá. A technological observation was developed on new cultivation and postharvest technologies for pitaya at the national and global level, as well as an evaluation of technologies that was conducted which were monitored against the inventory to determine those relevant to the production chain in Boyacá based on documentation of the experiences of producers. The diagnosis generated here is a basis for the planning of strategies for improving productivity and reducing production costs.

MATERIALS AND METHODS

A Technological characterization was carried out in the department of Boyacá, in the municipalities of Miraflores, Zetaquira,

Chitaraque, Briceño, Tununguá and Buenavista municipalities according to the URPA (2010) report where there were acreages in yellow pitaya (S. *megalanthus*) larger than 20 hectares (ha).

The focus of the study is qualitative-descriptive: not requiring the application of formulas to calculate the sample size or statistical analysis (Hernandez, *et a*l.,2002), implementing field visits, interviews and surveys of producers with the latter to directly study the characteristics of the population (Salkind, 1999) in their practices, technologies, materials and knowledge that are applied at each stage of production.

The methodology focused on obtaining a participatory diagnosis with the producers and gives insight into the issues that they believe affect them.

RESULTS AND DISCUSSION

The pitaya is a species that grows on farms where crops such as sugarcane (*Saccharum officinarum L.*), coffee (*Coffea arabica L.*), citrus (*Citrus sp.*), corn (*Zea mays L.*), avocado (*Persea americana Mill*) are produced, among others. A high percentage of producers are small farmers, whose main economic activity is agriculture and livestock.

The crop farmers who were interviewed stated they had from 500 to 14,000 plants. The average age of plantations varies in a range between 3 and 10 years, although crops planted up to 25 years ago were found. In recent years the planting of pitaya has increased in the municipalities of Tunungua and Briceño, which is why crops less than 3 years of age were encountered.

According to the finding of this investigation, crops in Boyacá thrive in an altitudinal range of 1200-1800 meters in regions with rainfall ranging between 2000 and 2800 mm /year -1 and temperatures between 18-20 ° C. Robolledo, *et al.*, (2001) indicate

that there is no scientific support to document the influence of environmental parameters on crop production, but according to the experience gained in practice by producers of yellow pitaya (S. *megalanthus*), suitable cultivation areas are between 1400 and 1700 meters, with temperatures ranging between 14 ° C and 26 ° C and precipitation between 1500-2000 mm / year -1.

PRODUCTION CHAIN:

a). Propagation material: vegetable material used is of vegetative type (stalk or stake), this material does not go through a nursery stage, but is sown directly in the field and often no disinfection processes are performed. The material is obtained from commercial crops in the same municipality. Producers do not have a standardized length of stalk for planting, which ranges between 50 and 120 centimeters (cm), but Suarez (2011) stated in his research that the stakes of a meter in length develop a greater number of buds compared to 0.5meters.

In Colombia there is no material that has been genetically neither selected, nor established management practices (Caetano, 2010). Cardozo *et al*., (2013) states that the leaves should be taken at least one meter in length and the size of the cutting is directly related to the time the plant enters production. It is also important to select mother plants preferably independent of commercial fruit production batches with optimal phytosanitary and physiological characteristics.

b.) Site preparation and plant support: for the preparation of the land, a general mechanization of the lot was not performed but rather the ground was prepared site by site, by scratching the surface and liming, adding organic matter and in some cases chemical fertilizers. These practices coincide with those published

by Agronet (2003), which specifies that soil preparation is done in a localized manner.

Two types of support are used: A simple trellis with wood or concrete poles and one or two lines of wire or *guaya*.. As plants grow, they are tied to the wire by strips of fabric or plastic. In the municipalities of Miraflores and Zetaquira, due to the conditions of surface stoniness on many lands, some producers use mounds of stone with an approximate height of 120 cm., on which each plant is supported. This situation had already been reviewed by Betancourt in 2010.

In research conducted at the Valle del Cauca with 4 types of support systems (square pen, triangular pen, "T" trellis or double or single trellis), it was concluded that: in the statistical analysis with the comparison test Tukey ($p < 0.05$), there were no significant differences between the structures that were tested, however, descriptive analysis shows that in the pens the most fruit was obtained from the evaluated crops, possibly due to the distribution of the leaves since these structures allow for a greater number of productive branches in the four cardinal directions (Medina *et al.*, 2011)

c) Planting is performed by placing the leaf or stake in contact with the ground. It should not be buried more than three centimeters, because the root system develops superficially. Sandy or loamy clay soils with good drainage and high organic matter content are required. In poorly drained soil conditions root rot occurs and in soils with high salt content crop development (Cardozo *et al.*, 2013) is delayed. Most crops are grown under shade of banana (*Musa sp.*) or native forest species. Experience indicates that growers should manage a balanced level of shade since it improves fruit quality and plant health, but can also reduce flowering and thus production.

d). Watering: Most crops do not have irrigation systems. A small number of producers have systems like sprinklers, micro sprinklers and drip irrigation. Rodríguez (2000), concluded that any proposed commercial production of pitaya should be irrigated. Installing irrigation systems was not initially considered as a technology for the production component, because there is the idea that the pitaya resists long periods of drought. However, it has been found that vegetative buds decrease, stems lose turgor, shoots appear deformed, parts of the plant die and there is no effect on floral induction. On the contrary, irrigation favors plant recovery and resumption of its development.

e). Fertilization is not done based on a soil test, but rather in an empirical manner. The products that are applied are organic, chemical or a mixture of the two. Among organic fertilizers, the most common are manure and compost. Chemicals are simple and compound fertilizers: coffee plantation (24/04/25) ,15-15-15, DAP di ammonium phosphate (18-46-0) and 10-30-10, among others. Some producers stated that the low quality of manure crops have been contaminated with nematodes, bacteria and fungi, so its use has begun to be restricted. The foliar application of fertilizers is not common. Sometimes they are performed in order to help thicken the fruit.

Agronet (2003) says that so far there are no studies that report the nutritional requirements of the crop, however it has been determined that this species has high potassium requirements, medium in nitrogen and low in phosphorus. The plant responds well to applications of organic matter. Fertilization should be split into two applications per year, which should preferably coincide with the end of the rainy season. The application of foliar fertilizer helps the development of the plants growth stage and promotes flowering and fruiting of plants in the production phase.

F). Weeds: weeds can be very harmful for growing Pitaya mainly in the early stages of the plantation, immediately after sowing or transplanting because at this stage the plant is very small and in a period of adaptation and does not tolerate high competition for nutrients (Agronet, 2003).

Weeding is done mainly with scythe (with the cutting head set for stihl trim cut) and machete. Frequency depends on the development of weeds. There are few applications of herbicides (one or two per year).

Weed management must be performed with plating plant practices, mechanical control with machete or scythe, native plant establishment and use of registered herbicides (ICA, 2012).

g). Pruning is performed three ways- for training, sanitation and production. .The first is done to facilitate management and cultivation practices. The second is performed to remove the diseased stalks, and the third to induce the plant to flower and fruit by cutting the tips and stunting of the branches. These three types of pruning are mentioned by Castillo *et al*., (2005), but warn that pruning is necessary to determine whether the "production" affects the productive life of the plant.

h). Phytosanitary problems: According to what producers have said, most limiting diseases are: basal rot of the fruit (.*Meloidogyne spp*), bacterial blight (*Fusarium spp*), and nematodes (*Erwinia carotovora*). Some producers report that if there is not adequate control, the impact of these diseases can reduce production by more than 30%.

In Valle del Cauca baseline fruit rot caused by *Fusarium* spp. is the main limiting factor in production in most commercial orchards. There is a more than 70% incidence rate disrupting the quality of the fruit and making it difficult to market the fruit in domestic and international markets (Riaño *et al*., 2013). In Nicaragua it is reported that the most limiting stem rot disease is

caused by *Erwinia carotovora* pv. (OIRSA, 2000) and in Mexico Ramirez (2011) identified strains of the genus *Glomerella* sp. And *Colletotrichum* in isolates made in cultured red pitaya.

With regard to nematodes, in the investigation made by Medina and Kondo (2012), nematodes (Meloidogyne spp.) were not considered a limiting pest in the cultivation of yellow pitaya, which differs to that mentioned by the producers interviewed in Boyacá previously mentioned by Rojas *et al.*, (2008), who mentioned the susceptibility of the crop to different nematodes being the most limiting factor for its wide distribution (*Meloidogyne* spp.).

The main problem that was mentioned was entomological flower bud (*Dasiops saltans*) *which* coincides with the report of Kondo et al. in 2011 on the flower bud fly as a limiting pest in the production of pitaya, according to Boyacá farmers. When no control on this fly is done, the losses can amount to 80% of production and is similar to what happens in the municipalities of Bolivar, Restrepo and Trujillo in the Cauca Valley, where damage to production reaches up to 80%. (Kondo, *et al.*,2011).

i). Harvest: The ripening of the fruit occurs first in the basal part and goes up to the middle and upper parts. First the thorns are removed and then it is cut. To remove the thorns, brushes, brooms or thick gloves are used. The brushing should be the base of the fruit towards the end (Martinez *et al.*, 2013). The cutting is done with clippers. Immediately after cutting it is placed in plastic baskets with 20-25 kg of capacity. There are 3 or 4 crops a year, with two principal harvests and the rest are known as "*traviesa*" (*naughty* in Spanish) or "*mitaca*" and have lower productivity.

j). Postharvest: the fruit is selected and sorted. Seven categories are used which are given different names: Export, warehouse, first, second, third, fourth, itchy or fungus, Semi, and select, among others.

Post-harvest crop losses according to MADR (2006) reached 8% of production. It is important to note that 95% of Colombian yellow pitaya consumption in the world is given as fresh fruit, with the remaining 5% consumed in other presentations such as dry flakes, frozen and canned in syrup (JRC. 2006).

k). Crop waste management : There are basically two types of waste residues: the pruning material and pesticide packaging. Pruning residues have different destinations: some are left in the field to decompose, others are buried or burned, and others are used in the production of organic fertilizers. If sanitary pruning has been done, it is recommended to bury the waste, apply lime and cover them (ICA, 2012).

The packaging of pesticides generates contamination because there are no clear mechanisms for disposal and sometimes they are left in the planting fields and in other cases, producers burn or bury them.

MARKETING LINK

Regarding marketing, most producers sell to intermediaries who pick up the fruit on the farm. It is common that the broker or buyer makes a reclassification of the fruit. Some producers take fruit directly to the main market of the country in Bogotá - "*Corabastos*". The requirements of the intermediaries in terms of quality of the fruit vary with the existing supply on the market. In times of scarcity all qualities are received, however, in times of abundance only fruit of the highest quality (export, first, and second) are accepted. Payment is usually made 15 or more days after the reception of the fruit by the intermediary.

Caetano, *et al*., in 2006 notes that high returns on export sales are handled, and there is no marketing system that allows

for organized and prompt delivery to put a certain amount of fruit on the domestic and international markets.

This is one of the major difficulties of the producer, as prices placed by intermediaries are low and do not allow for the profitability expected of the crop.

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