



As from the beginning of the process of adoption of the technology by mango exporters, in 1991 and until 2015, exports increased 17.2% because of the opening of US and Japanese markets to Brazilian fruits. This increase generated an income of 1.4 billion Brazilian reais, or 403.1 million US dollars. This is equivalent to an annual income of 57.4 million reais or 17.2 million US dollars in the last 25 years. In 2015 alone, mango exports to the US and Japan were increased by 22.1%. The more than 471 tons of mango exported in the period to the two countries generated more than 47 thousand jobs in the mango production and distribution chain.

The cost of the technology (considering generation and technology transfer from 1987 to 2003) was estimated in 2.4 million Brazilian reais when the average values in 2015, or the equivalent to 723.4 million US dollars, are considered.

The main beneficiaries of the technology are mango exporters, mainly from the San Francisco Valley in the states of Bahia and Pernambuco, and also São Paulo, Rio Grande do Norte, Ceará and Minas Gerais. In 2015, the states of Bahia and Pernambuco were responsible, respectively for 51.1% and 28.6% of the total exports of mangoes, representing almost 80% of the total exported.

The value of mango exports to the US and Japan grew at a rate of 6.8% per year during the period 1991-2015. This means that 46 million Brazilian reais can be added to mango exports each year, almost 14 million US dollars. This income is total production of approximately 13 thousand tons of mango entering the market annually. Considering only the agricultural segments of the mango production chain, this is responsible for the creation of 1.3 thousand jobs per year.

All states that export mangoes to the United States of America and Japanese markets can use the technology, which requires the hot-water immersion treatment as a necessary condition to entry those countries. The main mango exportes in 2015 were Bahia, Pernambuco, São Paulo, Rio Grande do Norte, Ceará, and Minas Gerais.



Photo: Nelson Fonseca

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# Research Highlights

Outstanding Technologies that must be known



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## HOT-WATER IMMERSION TREATMENT OF MANGOES



*Research Highlights* has been created by Embrapa Cassava & Fruits as a communication channel aimed at disseminating important results of the work performed by researchers dedicated to solve the production constraints faced by the crops which are part of our mandate.

Embrapa Cassava & Fruits was created in 1975. It has the national mandate to coordinate research programs involving mainly tropical fruits (banana, Barbados cherry, citrus, passion fruit, papaya, pineapple), and cassava. The research center has its headquarters in the city of Cruz das Almas, State of Bahia, with advanced posts located in the States of Paraná (South), São Paulo (Southeast), Mato Grosso (CenterWest), Rio Grande do Norte (Semi-Arid Northeast) and two other locations in Bahia. The center has a staff comprising 147 researchers and analysts, 57% of them with a doctoral or post-doctoral degree, and 37% with a M.Sc. degree. Additional administrative, laboratory and field staff completes the total number of employees, equal to 224 staff members. A considerable number of students are also performing thesis studies and participating in the research activities of the center.

Over the years, Embrapa Cassava & Fruits has obtained research results that certainly

contributed for the improvement of the agricultural sector, as a result of the work done by its scientists and staff members in general. There are dozens of technologies, products and processes that deserve the name of “good research”, but also those that can be named “Research Highlights”, with an outstanding performance, and with a strong impact in the field and in the market.

This publication reports successful cases of our research history, and has as its main objective to inform our partners and/or potential partners about outstanding results obtained by the Center. It is important to say that we seldom work alone; our research highlights were generated by teams of researchers composed by our staff members and representatives of many partner institutions across the country, and across the world.

By publishing *Research Highlights* Embrapa & Fruits expects that our partners, collaborators and the general public are well informed of our contribution to the splendid growth of the agricultural sector in Brazil in recent decades. We expect that new partners are found and share their experience with us, establishing new partnerships, and that those who generated and disseminated our research results are given the right recognition for the good work!

## Hot-water immersion treatment of mangoes

With the rise of the fruit crops sector in the San Francisco Valley, particularly in the states of Bahia and Pernambuco, mango production was strongly promoted and substantially increased. However, and as a result of this increase in mango production, the internal market was nearly saturated because exports of fruits were limited by the presence of fruit flies (Tephritidae) and the lack of a treatment that could guarantee the absence of larvae and eggs of the insect, as requested by the US and Japanese markets.

A joint work of Embrapa and the University of São Paulo generated a treatment that truly eliminates larvae and eggs of the insect in mango fruits. The method, known as hot-water immersion treatment (immersion of fruits in water at 46 °C (114.8 °F) for 75-90 minutes) was adopted by exporters and used since 1991, and was accepted by both US and Japan as an effective treatment to prevent the entry of fruit flies in their territories.

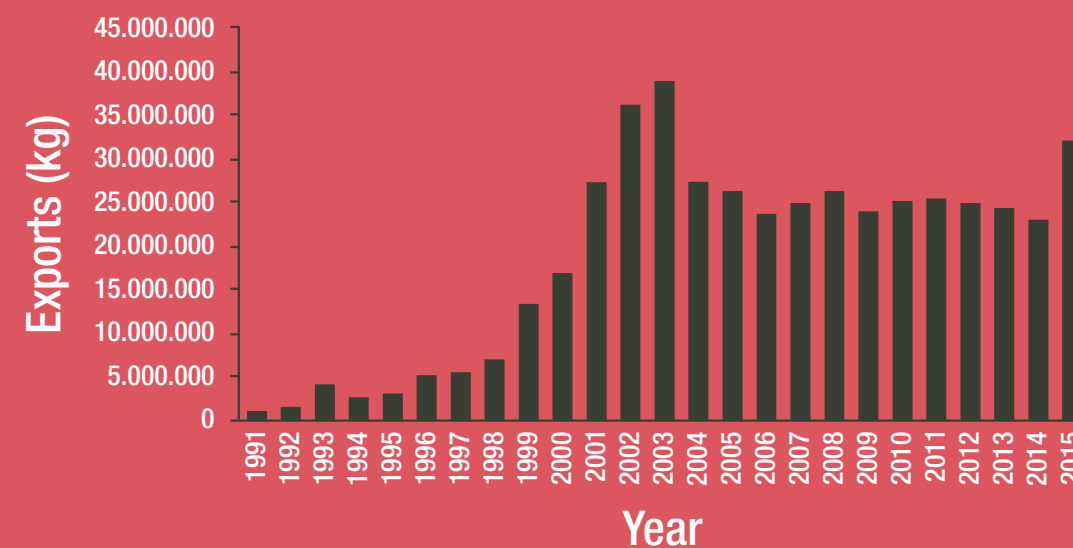
As a result of the increase in exports to the US as from 1992, plus the newly opened Japanese market in 2002, the volume of mangoes exported raised from one thousand tons in 1991 to 32.1 thousand tons in 2015 (Figure 1), or 652 thousand US dollars in 1991 to 34.5 million US dollars in the same period (Figure 2). The revenue obtained with mango exports to Europe, the US and Japan from 1991 to 2015 represents a total of 2.1 billion US dollars, as demonstrated by statistics obtained in the period (ALICEWEB, 2016).

## REFERENCE

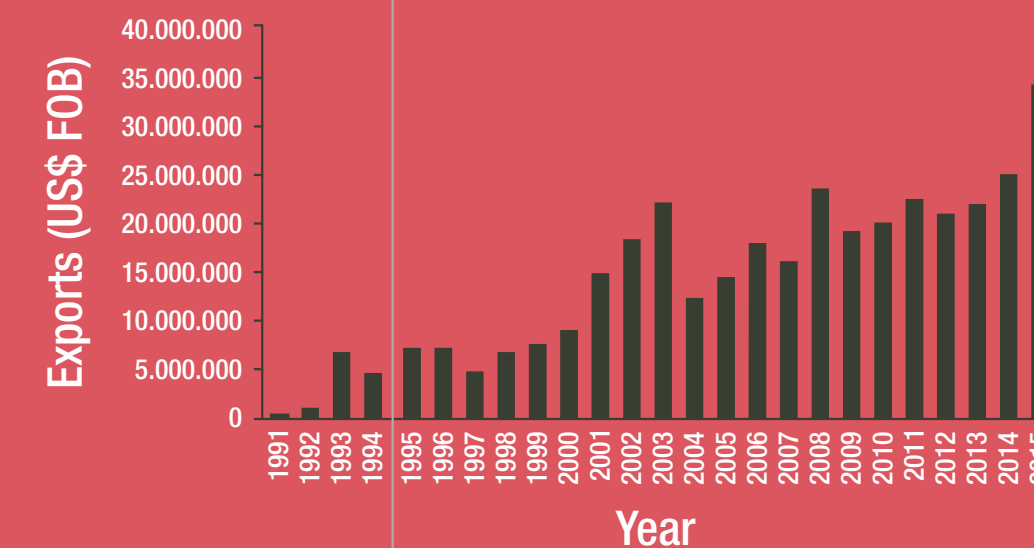
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Photo: Nelson Fonseca



**Figure 1.** Mango exports to the USA and Japan (kg of fruits)  
Fonte: ALICEWEB (2016)



**Figure 2.** Mango exports to the USA and Japan (US\$ FOB)  
Fonte: ALICEWEB (2016)