São Francisco River Valley as a New Belt for the Brazilian Citrus Industry

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Abstract
The citrus industry is one of the most relevant segments of the Brazilian agribusiness, being responsible for 40% of the sweet orange production and 60% of the juice processing in the World. Some factors for this hegemony are the adequate ecological conditions, which allows for cultivation without irrigation, and huge land availability. Threats, however, exist especially at the core of national production, in the State of São Paulo. The most important, bacterial and virus diseases, appear with increasingly incidence and destructive power. The Northeast Region, the second national producing region, apparently presents the best conditions for the citrus industry expansion. Among potential areas, the São Francisco Valley appears as one the best options due to the semi-arid climate, governmental support and tradition in the irrigated fruit production and export. The region, with 360,000 ha potentially irrigable, is located between 8 and 9°S and 40 and 42°W and altitude of 300 m a.s.l. The annual rainfall is less than 600 mm and the average temperature is 26.2°C, relative humidity of 67% and solar radiation of 3,000 h/year, constituting a comparative advantage to species such as acid lime, lemon and grapefruit. Citrus scions and rootstocks trials have been carried out since the 1990s by Embrapa in cooperation with the private sector in the States of Bahia and Pernambuco, which results are presented in this paper, showing the potentiality of the São Francisco Valley as a new belt for the Brazilian citrus industry.

Keywords: Citrus spp., climate, geographical regions, semi-arid, cultivars

INTRODUCTION
The Northeast region is located between 2 and 18° South latitude and between 35 and 50° West longitude. The weather is warm (tropical), with average annual temperatures ranging between 20 and 28°C and precipitation ranging from 300 to 2,000 mm. The total solar radiation per year varies depending on geographic location, altitude and rainfall, ranging from 1,800 in high altitude areas to 3,176 h in semi-arid areas (Ramos et al., 2009). The number of sunshine hours ranges from 2,300 per year in wetlands and 3,000 hours in semi-arid areas. The region includes the states of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe and Bahia. Although far from the State of São Paulo, the first orange producer, in the Northeast there are the second and third largest producer states, Bahia and Sergipe, respectively.

SÃO FRANCISCO RIVER VALLEY
The “Old Chico” is treated as tenderly or “river of national integration” crosses five states: Minas Gerais, which rises in the Canastra Mountain, Bahia, Pernambuco, Sergipe and Alagoas, where it empties into the Atlantic Ocean after transposing a distance of 2863 km. Ranked as High San Francisco, Middle, Lower Basin and Lower San Francisco the San Francisco Valley covers an area of 636,920 km² (Fig. 1).
Fig. 1. Map of Brazil showing the São Francisco River Valley.

The Lower Basin, which includes the Petrolina-Juazeiro Belt, covers the states of Bahia and Pernambuco an area of 115,986 km$^2$ or 18.2% of the Valley area. The cluster comprises the municipalities of Petrolina, Lagoa Grande, Santa Maria da Boa Vista and the State of Pernambuco, Orocó, Juazeiro, Sobradinho, Casa Nova and Curaçá in Bahia (Fig. 2). The socioeconomic development of the region resulted from the stimulated increase in the fruit production, especially mango and grapes.

Fig. 2. Map highlighting counties of the Petrolina-Juazeiro Belt.
CLIMATE AND SOILS

The region is located between 8° and 9° South latitude and 40° to 42° West longitude and altitude to stand at around 300 m a.s.l. According to the Koppen climate classification, the climate is ‘BSwh’, very hot and semiarid. The rainfall is less than 600 mm in the period from November to April and temperatures never below 24°C even during winter (March to August). The average annual temperature is 26.2°C, relative humidity of 67% and solar radiation around 3000 h/year, giving a comparative advantage for the region in terms of biomass production and vegetables, particularly fruits, supplemented by water via irrigation. This is due to the high solar radiation conditions in the region, and only one in the country in regard to the potential of the production of grapefruit and limes. The main soils found in the Lower Basin of the São Francisco are low in phosphorus and organic matter. The vertisols found in Bahia have high pH and low availability of micronutrients. The planosols and ultisols usually have pH below 7 (Silva et al., 2007).

FRUIT PRODUCTION IN PETROLINA – JUAZEIRO BELT

The privileged climatic conditions account for the performance of the fruit both domestically and in the context of exports. According to the Commission for the Development of the São Francisco Valley - Codevasf, there are 360,000 ha in the Petrolina/Juazeiro Belt but 120,000 ha are currently irrigated under mango, grapes, banana, guava, coconut, acid lime, papaya and other crops such as sugar cane, vegetables and subsistence crops, and in 2004 reached the top mark of 1 million tons of fruit. Studies by the Development Company of the São Francisco Valley and Parnaiba (CODEVASF, 2006) show unrestrained demand of the ‘Persian’ acid lime in the Northeast in the early decades of the century. The leading products of the production in the Bahia / Pernambuco belt in 2009 were mango which accounted for 50.90%, grapes with 26.25%, and banana with 11.14% (Table 1). Analyzing the performance of the products between the years 2008 and 2009, papaya showed the best performance, with growth in the two poles in the area harvested 14.26 and 8.71% in production, followed by mango, with 0.78% growth of harvested area and 4.80% in production (IBGE-SIDRA, 2012).

Table 1. Harvested area and fruit production in the Petrolina-Juazeiro Belt (2008).

<table>
<thead>
<tr>
<th>Product</th>
<th>Harvested area (ha)</th>
<th>Production (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mango</td>
<td>20,420</td>
<td>441,754</td>
</tr>
<tr>
<td>Grapes</td>
<td>9,214</td>
<td>249,928</td>
</tr>
<tr>
<td>Banana</td>
<td>9,117</td>
<td>161,826</td>
</tr>
<tr>
<td>Guavas</td>
<td>3,130</td>
<td>83,850</td>
</tr>
<tr>
<td>Papayas</td>
<td>1,042</td>
<td>21,988</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42,923</strong></td>
<td><strong>959,346</strong></td>
</tr>
</tbody>
</table>


Regarding citrus species, the fruit production is absolutely insignificant. Using the values computed by IBGE in 2009, statistics are only presented for the lime (limes), whose acreage is minimal if taken into account potential of the region and the demand for this species in the world market: 311 tons of fruits in a cultivated area of 128 ha and a yield of 16 t/ha which is very low. Codevasf has been making efforts to create an adequate infrastructure for sustainable development of horticulture with emphasis on fruit crops diversification. The projects denominated Salitre and Pontal represented the effort to create the necessary logistics for the deployment of a powerful agro-industrial park. The Salitre project is located in Juazeiro (BA) comprising 31,305 ha and the Pontal in the municipality of Petrolina (PE) with 7,717 ha.
SCIONS AND ROOTSTOCKS CULTIVARS SUITABLES FOR PETROLINA – JUAZEIRO BELT

Among the group of sweet oranges, trials for the comparison of cultivars established in Petrolina (PE), in 2007, have shown that some clones of ‘Pera’ orange (predominantly cultivated in the Northeastern Region) are doing very well, as the cultivars ‘Salustiana’, ‘Pineapple’, ‘Ruby’, ‘Westin’, ‘Sunstar’, ‘Kona’, ‘Jaffa’, ‘Torregrosso’, ‘Natal’ and ‘Valencia Tuxpan’. The Navel group does not behave well under these conditions, while the late season sweet orange cultivars bears abundantly fruits of high quality. Regarding fruit quality, the external color is pale but the juice content is satisfactory and the ratio permits to anticipate the harvesting which is very desirable by the Brazilian market. In the group of mandarins, although recognizing as the less recommended, the cultivar ‘Page’, hybrid from clementine and ‘Minneola’ tangelo and ‘Piemonte’, hybrid from clementine mandarin x ‘Murcott’ tangor are considered as potential cultivars. It must be emphasized, however, that according to the environmental conditions of the Valley, grapefruits, Persian lime, Key lime and lemon are the species with the highest possibilities of acclimatization allowing the establishment of an agro-industrial activity with strong growth prospects (Passos et al., 2002).


These hybrids were obtained by Dr. Joe Furr at the Dates and Citrus Experiment Station, in Indio, California, in the XIX century and introduced in Brazil by Dr. Dalmo Giacometti in the 1970s. Due the performance of these rootstocks under different cultivars and conditions, Embrapa has recommended recently as rootstocks specially adapted for the Northeastern region ‘Sunki’ mandarin × ‘English trifoliata 256’, ‘Sunki’ mandarin × ‘English trifoliata 264’ and ‘Sunki’ mandarin × ‘Swingle trifoliata 314’, denoting them as ‘Indio’, ‘Riverside’ and ‘San Diego’ citrandarins in honor to the birth place of this memorable researcher.

FINAL CONSIDERATIONS

Petrolina-Juazeiro Belt is a living example of the changes that can occur when a right political decision is taken. Based on the potential for horticultural products, the Government invested to make this region one of the greatest examples of fruit production and exporting. Citrus production by its characteristic of generating income and employment can be a real alternative for sustainable development in the semiarid northeast.

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Literature Cited


