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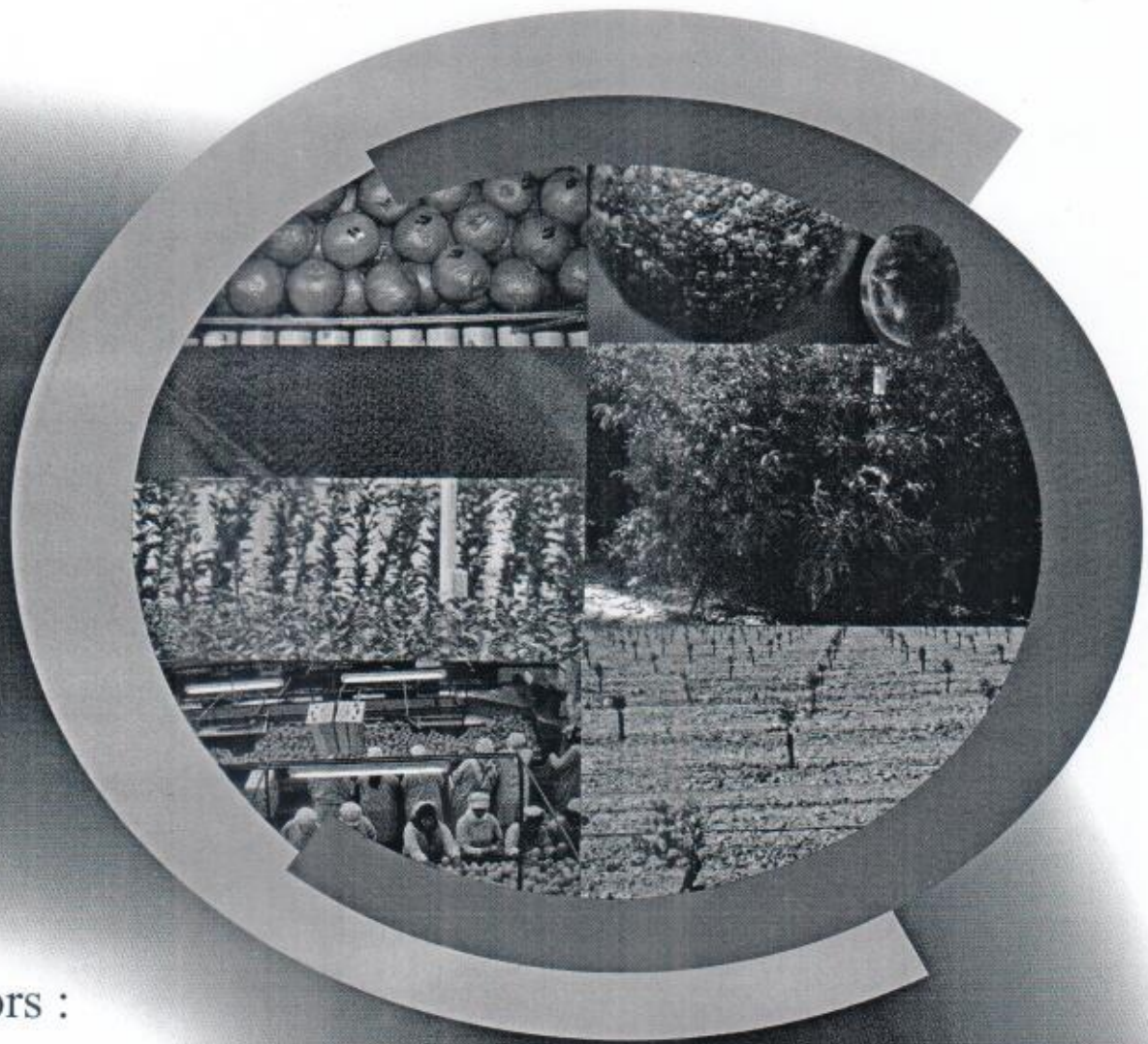
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A. Ait-Oubahou

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Citrus Industry in Brazil in the XXI Century

O.S. Passos and M.A. Santana

Embrapa Mandioca e Fruticultura, C. P. 007, 44380-000 Cruz das Almas - BA, Brazil

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Abstract This paper is a review on the citrus producing areas of Brazil, with emphasis on the geographical position, climate and soils, harvested areas, production and yield. Also presented, are the five geographical regions of the country with their respective producing States and locations. As final considerations, comments are made on the opportunities and threats in order to demonstrate the great economic and social importance of the citrus industry for the economy of the country and the losses due to abiotic and biotic factors. Considered as opportunities are: 1. The appropriate ecological conditions from the Amazon basin to Rio Grande do Sul State and what allows the installation of orchards without the obligatory use of irrigation. Also, the unlimited availability land contributes to expansion; 2. The citrus belt is near to the state capitals, taking advantage of the existing infrastructure (electric power, highways, sea ports and media); 3. Technologies developed mainly by the Instituto Agronomico de Campinas (IAC), and Embrapa (Empresa Brasileira de Pesquisa Agropecuária), and others; 4. The capacity and courage of the citrus growers. As threats to the sustainability of the Brazilian citriculture are mentioned: 1. The disorganization of the producers who are more concerned with their own interests. 2. The concentration of fruit production based on the sweet oranges as a group (89%). This is detrimental to mandarins, with only 5.9%, and the limes/lemons, with 5.06%; 3. The prevalence of the combination 'Pêra' orange on 'Rangpur' lime rootstock, limiting the supply of fruits to the market, besides making the citriculture vulnerable to diseases. 6. The diseases, mainly the virus and bacterial ones, are truly the main threats due to their destructive power, causing irreparable losses, especially when transmitted by insect vectors. However, since the 1980's the Brazilian citrus industry is leading the world citrus production and the export of concentrated orange juice.

The history of Brazilian citriculture is intimately linked to the history of the country. A few years after the discovery of Brazil, around 1530, the Portuguese introduced the first seeds of the sweet orange in the States of Bahia and São Paulo. Because of favourable ecological conditions, the trees produced very well (Passos, 1990). During the colonial period, the fruits of the 'Bahia' orange were recognized as being larger and juicier than those produced in Portugal. Nevertheless, only in the 1930's did citriculture begin to be implanted commercially in the States of São Paulo, Rio de Janeiro and Bahia, with greater growth rates in the states of the Southeast (Passos, 1990). There are no climatic limitations for citrus growing in Brazil. Irrigation is not necessary, except in the semi-arid areas of the Northeast where the rainfall is below 700 mm and in the south where frosts can occur. The altitude varies from 20 to 500 m. Rainfall varies from 1.00 to 1.800 mm, during the winter in the Northeast (March to August) and in the summer in the Southeast (September to March). In Rio Grande do Sul, the rainfall is almost monthly. The relative humidity is higher in the Northeast, where in the winter it almost reaches 100%, with the annual average being between 75 to 80%. The annual average temperature varies from 19°C in the South to 25°C in the Northeast. Independent of the area, flowering occurs in September, one or more times depending on the distance to the equator. The farther from the equator, the smaller are the fruits, but they stay on the trees longer. The soils of the citrus growing areas are sandy/loam, deep, well drained, but with poor fertility, especially in phosphorous. Except the shallow soils of some areas, like the cocoa growing area in Bahia, the humid Amazonian area or the loamy areas of the States of Paraná and São Paulo, where

coffee and sugar-cane are cultivated, there is an immense area which is available to the citrus industry in Brazil.

The present paper aims to show the extent of the citrus industry in the national territory under different ecological conditions and developmental levels. This differs from recent past when the citrus growing was concentrated in the developed areas of the Southeast and South.

The Brazilian citrus industry in the world context

An available data show why the citrus sector is of it is of great economic and social importance for the economy of the country. The area cultivated is about 1 million hectares and the production of fruit surpasses 19 million tons, the largest in the world since the eighties. However, the yield per tree (t/t/ha) is low compared to that of other countries. Brazil is the largest exporter of frozen concentrated orange juice, whose export value, together with other sub-products has been generating about 1.5 billion dollars annually. In the State of São Paulo alone it generates more than 500 thousand direct and indirect jobs. The following factors are responsible for the Brazilian citrus industry's leadership in world production: 1. Excellent ecological conditions from the Amazon basin to the State of Rio Grande do Sul. This allows the installation of orchards without the obligatory use of irrigation. The large area available facilitates the expansion of the plantings; 2. The more important producing areas are close to the capitals of the States, which already have infrastructure such as electric power, paved highways, marine ports and all means of communication; 3. Satisfactory support technologies generated mainly by AIC (Agronomic Institute of Campinas), Embrapa (Brazilian Agricultural Research Corporation) and some state companies, universities and

private companies such as Fundecitrus (Fund for Defense of the Brazilian Citriculture) and more recently the Bebedouro Citrus Experimental Station; and 4. The ability and the enthusiasm of the citrus growers who are committed to the development of the citrus industry in the country. Other indirect factors that influenced the market were the crisis in the coffee industry during the 1920's which led the São Paulo coffee growers to diversify into citrus growing and the successive frosts in Florida, mainly in the eighties, which stimulated the development of the processing of orange juice in São Paulo, which increased Brazil's exports tremendously. The favourable conditions, mentioned above, which were aimed at external markets with a high consumption capacity, have made Brazil the world leader in citrus production, with 18% of the market (Table 1).

Table 1. Cultivated area, production and yield of citrus fruits of the ten largest producing countries, 2001.

Country	Cultivated area (ha)	Production (1000 x tonnes)	Yield (t/ha)
Brazil	937,074	18,392.600	19.63
USA	441,065	14,701.920	33.33
China	1,420,530	12,017.000	8.46
Mexico	495,594	6,324.746	12.76
Spain	283,550	5,547.152	19.56
India	253,700	4,870.000	19.20
Iran	218,422	3,769.996	17.26
Nigeria	730,000	3,250.000	4.45
Italy	177,599	3,062.650	17.24
Argentina	125,533	2,706.000	21.56
World	7,249,480	102,648.184	14.16

Source: IBGE (2003) and FAO (2003)

The citrus industry in Brazil according to the geographical areas

Citrus fruits are cultivated in 22 of the 27 Brazilian states with about 99% of the total production coming from ten states: São Paulo, Bahia, Sergipe, Minas, Gerais Rio Grande do Sul, Pará, Santa Catarina, Goiás and Rio de Janeiro. These states are located in the physiographic areas of the Southeast, Northeast, South, North and Center West (Fig. 1)



Figure 1. Map of Brazil with the physiographic areas and states

The Southeast region is located between the parallel 14° and 25° South latitude and between 40° and 53° West longitude. The climate is a transition between the hot of low latitudes and the mesotérmic of the medium latitudes; however it is more tropical than temperate. The annual medium temperature varies from about 18° to 24°C. The rainfall is 1500 mm during the period of October to March, with the highest rainfall occurring during the summer months. This area includes the States of São Paulo, Rio de Janeiro, Minas Gerais and Espírito Santo (Fig. 2) and occupies 10.8% of the national territory.

Being the most developed area of the country, the Southeast also leads in the production of the citrus fruits with 75% of the harvested area, 83% of the production, as well as the best productivity rate; 22.34 t/ha (Table 2).

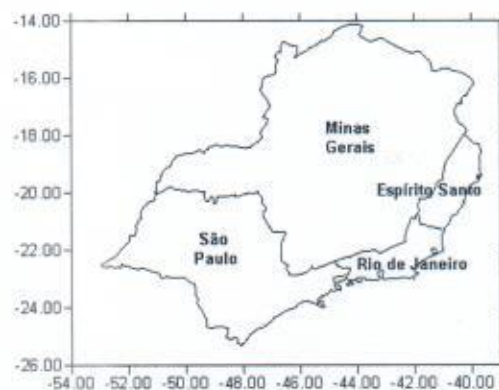


Figure 2. Map of the Southeast region of Brazil.

Table 2. Harvested area, production and yield of the citrus industry in the Southeast region of Brazil, in 2001

State	Harvested area (ha)	Production (t)	Yield (t/ha)
Espirito Santo	4,436	65,332	14.73
Rio de Janeiro	12,089	186,023	15.39
Minas Gerais	49,884	627,708	12.58
São Paulo	640,791	14,923.64	23.29
Southeast	707,200	15,802.127	22.34
Brasil	937,403	19,073.309	20.35

Source: IBGE (2003)

The State of São Paulo has led national citrus production since the thirties. It is responsible for approximately 80% of the national production and 70% of the harvested area. According to Fundecitrus (Personal communication), the group of the sweet orange (*Citrus sinensis* (L.) Osbeck) in the nurseries of São Paulo in 2000 represented 92.2% of the used varieties and of those 38% were Pera, 24% Natal, 21% Valência and 6.4% Hamlin. The mandarin group represented 3.8% composed of 'Ponkan', (*C. reticulata* Blanco) 2.3%, 'Murcott' (hybrid of orange with tangerina) 0.8% and 'Mexerica' (*C. deliciosa* Tenore) and in the lemons/limes group with 4.0%. The preferences were for the acid lime 'Tahiti' (*C. latifolia* Tanaka) (3.3%) and 'Eureka' lemon (*C. limon* Burm.f.) (0.6%). With regard to the rootstocks, the 'Rangpur lime' (*C. limonia* Osb.) represents about 80% of the orchards, although other varieties such as Cleopatra mandarin (*C. reshni*) Hort., Sunki mandarin (*C. sunki*) and Swingle citrumelo (*Poncirus trifoliata* (L.) Raf. X 'Duncan' grapefruit *C. paradisi* Macf) have been preferred recently due to the

occurrence of the "Morte súbita" disease. As was previously mentioned, the successive frosts that occurred in Florida stimulated great growth in the citrus industry in São Paulo, mainly in the eighties. The ability of the citrus growers to bring about this fantastic growth in the citrus agribusiness, which has reached more than US\$1 billion a year in exports and has generated 500.000 jobs, is also a key factor in this success story.

The demand for fruits for processing contributed for the stabilization of the fresh fruit market which was stable up to 1994, when juice exports to the United States began to decrease. The decrease in juice exports to the United States stimulated a growth in the fresh fruit market in Brazil from 19% in 1990 to 25% in 2000, as can be observed in Table 3.

Table 3. Citrus production in the State of São Paulo - processing, internal market and exports of fresh fruit (in millions of boxes of 40.8 kg).

Year	Production	Processing (%)	Internal market (%)	Exporting (%)
90/91	262,70	210,00	80	50,80
91/92	285,50	225,00	79	57,80
92/93	300,00	265,00	88	33,00
93/94	307,00	240,00	78	65,00
94/95	311,00	242,70	78	65,00
95/96	357,30	259,10	72	95,00
96/97	363,00	268,10	74	93,00
97/98	428,00	318,00	74	110,00
98/99	330,00	279,00	85	51,00
99/00	388,00	280,00	72	108,00
00/01	355,00	265,00	75	90,00

Source: Neves & Marino (2002)

Significant changes happened in the State of São Paulo after the reduction of American imports. The European Community and the Asian markets became more important. In 1997/1998, the two continents imported nearly 80% of Brazilian concentrated juice. At the same time, the commercialization system was modified: instead of the processors harvesting and transporting the fruits, the producers started to do these operations themselves. This increased their costs but they were not able to increase their price sufficiently to make up for the additional expense. However, the worst threats to the success of this industry are diseases. The most significant ones are: the citrus canker, clorosis variegated (CVC) and more recently the "morte súbita" (sudden death) whose dissemination causes serious damage to the citrus industry.

The Northeast region is located between 2° and 18° South latitude and between 35° and 50° West longitude. The climate is hot and super humid (tropical), with the annual temperature varying from 20° to 28° C and rainfall averages varying from 300 for 2000 mm. The number of hours of sun varies from 2300 hours a year, in the humid areas, to 3000 hours, in the semi-arid areas. Most of this area is located in the "Polygon of the Droughts" (below 750 mm) and it comprises the States of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe and Bahia. It occupies 18.2% of the surface of the national territory (Fig. 3).

Although it is considered the poorest area of Brazil, it includes the second and the fourth highest citrus producing states in the country (See the Tables 4, 5, 6 and 7).



Figure 3. Map of the Northeast region, Brazil.

Table 4. Harvested area, production and yield of the citrus industry in the Northeast region of Brazil, in 2001.

State	Harvested area (ha)	Production (t)	Yield (t/ha)
Rio Grande do Norte	452	4076	9.02
Pernambuco	1,656	8.197	4.95
Piauí	995	9.050	9.09
Maranhão	1,852	10.919	5.89
Paraíba	2,012	15.658	7.78
Ceará	2,902	26.065	9.02
Alagoas	4,155	36.573	8.80
Sergipe	51,224	595.011	11.61
Bahia	52,276	900.153	17.21
Northeast	117,524	1,607.567	13.68
Brazil	937,403	19,073.309	20.25

Source: IBGE (2003)

Bahia is the second highest citrus producing state in Brazil. It is noted in the history of Brazilian citriculture by being one of the entrance doors for the first seeds of the sweet orange which originated in Portugal and for being the home state of the 'Bahia' orange, a variety which has contributed greatly to the development of the citrus industry in the world (Passos, 1979). From 1990 to 2000 Bahia had one of the highest growth rates in the country with respect to harvested area and production: 5.84% and 5.68% respectively. There is in the state a large area available for the expansion of citrus growing, mainly in the Recôncavo, the North coast, in the West and in the South. The North Coast is the principal producer, representing more than 65% of the state production. This production comes in a large part from small proprietors (it is estimated that more than 80% of the citrus growers are small farmers, cultivating less than 20 hectares). A similar situation exists in the neighbouring State of Sergipe where there is pressure to expand the growing area. As is shown in Table 4, the productivity of citriculture in the Northeast is low, inferior to the national average. The causes of lower productivity in Bahia, are: lower technical skills of the growers and the lack of organization of production and commercialization systems. In order to attend to the demand for concentrated juice, the 'Bahia' orange was replaced by the 'Pera' orange which is grafted onto 'Rangpur' lime. The 'Pera' orange constitutes almost 100% of the orchards. We estimate that 40% of the orange production is being processed. Bahia is located at 12° South latitude

and consequently produces orange fruits that are typical of the tropical conditions: larger, more succulent, less colored and less acid than those produced in subtropical conditions. The best strategy for increasing the citrus industry in Bahia could be: 1) to expand the exportation of 'Bahia' orange after de-greening to the market of the Southeast, 2) to expand the production of mandarin hybrids and 3) to increase the production of acid lime and grapefruit, especially along the São Francisco valley where the conditions are more appropriate for these species in Brazil.

The Southern region is located between 22° and 34° South latitude and between 48° and 58° West longitude. That area has a mesothermic (subtropical) climate with a rainfall average from 1250 to 2000 mm which is well distributed throughout most of the year. It comprises the States of Paraná, Santa Catarina and Rio Grande do Sul (Fig. 4).



Figure 4. Map of the Southern area of Brazil.

Rio Grande do Sul is the fifth highest citrus producer in the country. It is the state that has the best climatic conditions for producing fresh fruits of very high quality which make them excellent for exporting. It stands out among the producing states for being well located, around 30° South latitude. It has a larger thermal width than most other areas, and has a rainfall of 1.200 mm distributed throughout the year. In contrast to the other states, the 'Valencia' orange, grafted on trifoliolate, is the predominant variety. A local selection of mandarin ("bergamota" as it is known locally) is also cultivated extensively. However, the low growth rate for the orange harvested area and production rate during the period of 1990 to 2000, 0.71% and 0.21% a year, respectively, was disappointing, considering the climatic advantages of the region (Table 5).

Table 5. Harvested area, production and yield of the citrus industry in the South region of Brazil, in 2001

State	Harvested area (ha)	Production (t)	Yield (t/ha)
Santa Catarina	12,449	155.694	12.51
Paraná	27,225	515.713	18.94
Rio Grande do Sul	41,755	545.172	13.06
South	81,429	1,216.579	14.94
Brazil	937,403	19,073.309	20.35

Source: IBGE (2003).

The Northern region is located between 5° North latitude and 15° South latitude and between 45° and 80° longitude west. It includes most of the Amazon basin, where the largest humid tropical forest in the world is located. The "legal Amazonian" area occupies almost the half of the national territory, including States of Amazonas, Pará, Amapá, Roraima, Acre, Rondônia and Tocantins (Figure 5). The climate is a hot, super humid (equatorial), with the annual average temperature varying from 24° to 26° C and the rainfall averaging from 1500 to 3000 mm.

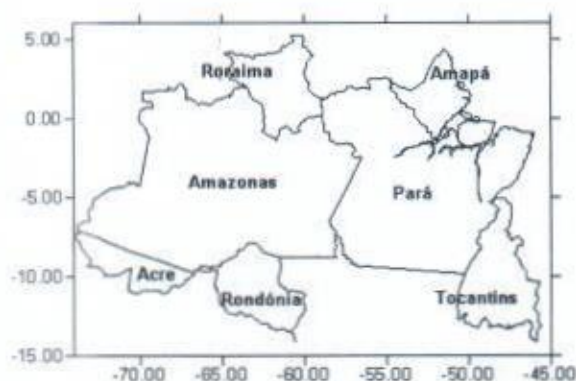


Figure 5. Map of the Northern area of Brazil.

Table 6. Harvested area, production and yield of the citrus industry in the North region of Brazil, in 2001

State	Harvested area (ha)	Production (t)	Yield (t/ha)
Tocantins	272	2.881	10,59
Roraima	469	3.059	6,52
Acre	788	6.449	8,18
Amapá	762	7.868	10,33
Rondônia	1.064	10.929	10,27
Amazonas	3.330	16.447	4,94
Pará	13.544	221.905	16,38
North	20.229	269.538	13,32
Brazil	937.403	19.073.309	20,35

Source: IBGE (2003).

The State of Pará is one of the newest citrus producing area. From 1990 to 2000 it had the largest growth rate for oranges when compared with the other producing states respectively with: 9.74% and 6.70% a year for harvested area and production. The Amazonian States have the advantage of being closer of the U.S. and European markets than the other Brazilian states. However, the fruit quality of orange is not attractive because the peel doesn't have the typical color required for commercialization, staying green, even in the maturation stage. The grapefruit and some mandarin hybrids would be the best alternatives for this area.

The Center-west region is between 5° and 25° South latitude and between 45° and 70° West longitude where Brasília, the capital of the country, is located. It also includes the States of Goiás, Mato Grosso and Mato Grosso do Sul (Fig. 6). The temperature varies from 15° to 26° C and the rainfall from 1250 to 3000 mm.

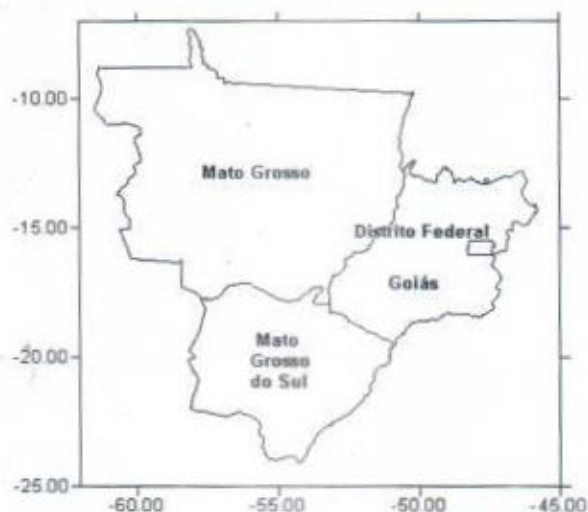


Figure 6. Map of the Center-west region, Brazil.

Table 7. Harvested area, production and yield of the citrus industry in the Center-west region of Brazil, in 2001

State	Harvested area (ha)	Production (t)	Yield (t/ha)
Mato Grosso do Sul	797	11.978	15,03
Mato Grosso	1.486	14.933	10,05
Distrito Federal	915	16.459	17,99
Goiás	7.823	134.428	17,18
Center-west	11.021	177.798	16,13
Brazil	937.403	19.073.309	20,35

Source: IBGE (2003)

The State of Goiás is located in an area with special characteristics (flat and well-drained soils and an abundance of water and high termic amplitude). These savannahs cover more than 200 million hectares. The growth rate for oranges harvested and orange production, for the period 1990-2000, was 5.19% and 5.81% a year, respectively.

Final considerations

Considering the economic and social importance of the citrus industry in Brazil, the Government and the private sector should consider the following observations:

Opportunities

1. The government and the private sector should recognize the extraordinary development in the citrus industry, mainly in Sao Paulo, and its impact on the economy and employment opportunities. The citrus industry has made a tremendous contribution to the positive trade balance of the country. The exportation of concentrated orange juice and other by-products has generated more than 1 billion dollars a year in income. The industry has produced almost 1 million direct jobs nationally, which is more than the number generated by the automotive industry.

2. The government and the private sector should encourage the dispersion of citrus growing throughout the five physiographic regions of the country. This would be a change from past policy which has been concentrating in the development of the industry in the Southeast region of the country. The government and the private sector should make an effort in the development of the citrus industry in poorest areas of the country, which are located in the North and Northeast.
3. The potential of each region to produce fruit of different species in accordance with climate conditions should be explored. For example, in the South fresh fruit production should be encouraged, in the Southeast, both fruit and processing should be produced while in the North and Northeast the growing of acid lime, grapefruit and mandarin hybrids should be encouraged.
4. The government and private sector should stress to the public the health benefits of citrus fruits and encourage their consumption. They should point out to the public the importance of vitamins, mineral salts, especially vitamin C and other elements such as flavinoids that citrus fruits provide.

We would like to mention here the threats to the sustainability of the citrus industry on the national level

1. The lack of organization or cooperation among the growers, who are more concerned with their own interests than with the development of the industry as a whole. This makes them more vulnerable to exploitation, especially when it involves the commercialization of the products.
2. The overemphasis on the production of the group of the sweet orange, which represents 89% of citrus production compared with only 5.9% for mandarins and 5.06 % for lemons/limes.
3. The predominance of the combination of 'Pera' orange on 'Rangpur' lime. This reduces the diversification of fruit available to the market and, more importantly, makes the industry vulnerable to diseases. We estimate that there are more than 150 million trees with that combination.
4. Diseases, mainly the virotic and the bacterial ones, are the greatest threats to the industry because they can cause irreparable losses. The most harmful diseases are those transmitted by insects. We list these diseases below according to their occurrence, beginning with the most recently observed case and ending with the oldest reported disease.

Sudden death or "morte súbita dos citros" (MNC) was observed for the first time in 1999 but was not until 2001 that Fundecitrus identified the disease. It was first discovered in the northern region of the state of Minas Gerais in a 12 year old 'Valencia' orange grafted on 'Rangpur' lime rootstock. Later, in the State of Sao Paulo, symptoms were observed in Pera, Hamlin, Valencia orange varieties grafted on 'Rangpur' lime and in 'Natal' orange on 'Volkamer' lemon. These symptoms were found in trees of different ages. The symptoms are: the loss of shine on the leaves with some external flushing caused by the dysfunction of the phloem in the rootstock which produces a yellow coloration to the phloem. The obstruction of the phloem is responsible for the death of the roots, which is a characteristic found in all of the infected plants. The Silvio Moreira Center for Citriculture named the disease "sudden death" because the time between the emergence of the symptoms and the death of the plant is so short. Although it has not yet been

confirmed, it is believed that tristeza virus could be the causal agent of the "morte sbita dos citros". It is transmitted by the aphid *Toxoptera citricida* which is present in all Brazilian orchards. Up to the present time 3 million trees have shown symptoms or have died due to MSC in the two states in which the disease has been found, representing a loss of 60 million dollars.

Citrus variegated chlorosis (CVC) - considered the most serious disease for the Brazilian citrus industry. It was first observed in 1987 in orchards in the State of São Paulo and later in all the producing states. The main symptoms are: chlorosis of the leaves, initially in the middle and upper part of the tree and later in the whole plant. Leaves with nutritional deficiencies, with bubbles of straw color in the number face corresponding to chlorotic stains in the ventral face. The fruits are small and hard, with a precocious yellow color which makes them difficult to market as fresh fruit. In very infected plants, branches in the upper part of the tree have very diseased leaves, small fruits and also loss of leaves. The causal agent is the bacterium *Xylella fastidiosa* which has vectors in 11 species of cicade of the Cicadellidae family. Symptoms are observed in all the varieties of sweet orange, independently of the rootstock. The mandarins, acid limes, grapefruit, lemons, 'Murcott' tangor and 'Orlando' tangelo are considered not susceptible. The most efficient control is the use of healthy plants, coming from protected nurseries. Other cultural practices in the plants and in the soils, as well as the control of the cicadas are also recommended. CVC appears in 34% of the orchards of São Paulo and 6 million trees are in terminal phase. According to Fundecitrus, due to the emergence of the canker and of the variegated chlorosis of the citros (CVC) in the orchards of São Paulo, the annual losses are estimated to be 240 million dollars.)

Decline -The disease "decline" was discovered in the decade of the 70's. It is a very serious disease because it affects the commercial varieties that are grafted onto the 'Rangpur' lime, 'Volkamer' lemon, 'Rough' lemon (*C. jambiri*), Lush and trifoliate rootstocks. It occurs in all producing areas. It appears not to be harmful to mandarins. The symptoms of the disease are visible in plants that are from 7 to 10 years of age. The growth of the plant is paralyzed and the leaves wither and fall. Although the root system is normal, the plant begins to decay due to the destruction of phloem and the decrease in water absorption and eventually it dies. It is estimated that in the state of Sao Paulo this disease causes a loss of 200 million dollars annually.

Citrus canker - This disease came from Southeast Asia. It was first identified in 1957 in Sao Paulo. It was then dispersed through propagative material and fruits throughout the south (Rio Grande do Sul, Parana and Santa Catarina), the southeast (Minas Gerais) and Center-west (Mato Grosso do Sul). There has been no evidence of this disease in the North and Northeast areas. The symptoms appear in the leaves, the fruit and in new branches and occur at any age of the plant. In the leaves, clear stains appear which necrosis later in the center. On the fruit, the lesions are brown and in the more advanced stage of the disease, look like crusts with fissures through which the bacterium (*Xanthomonas axonopodis* pv. *Citri*) exudes. This bacterium is the causal agent of the disease. In the young branches the canker can form salient crusts of a brown color. Studies done in the state of Parana show there is a susceptibility/resistance scale

among the commercial varieties. The 'Bahia' and 'Hamlin' oranges stood out as the most susceptible while the 'Folha Murcha' proved to be the most resistant. The mandarins and the acid lime 'Tahiti' are resistant. The most effective control is eradication. Since it was discovered in Brazil, the Ministry of Agriculture and the state governments, especially the state of Sao Paulo, have made significant efforts to eradicate the disease. When the leaf miner (*Phyllocnistis citrella*) appeared the dissemination of the canker increased considerably. The number of foci in Sao Paulo increased 320% from 1996 and 1997. It is estimated that more than 3 million nursery plants and 1/2 million adult plants have been eradicated in the state of Sao Paulo because of this disease.

Tristeza. The history of the Brazilian citrus industry can be divided into two periods: the period before and the period after the discovery of Tristeza, such was the impact of its occurrence in 1937, when more than 10 million plants that were grafted on the 'Sour' orange (*C. aurantium* L) died. That represented 70% of the plants cultivated at that time. Trees with the Tristeza virus disease decline rapidly and show typical symptoms of exhaustion. The branches in the upper part of the plant become dry, the roots become rotten and necrosis occurs in the sieved tubes of the 'Sour' orange. The black aphid (*Toxoptera citricida*) is the most effective vector in Brazilian orchards. Another symptom of the Tristeza virus is stem pitting those results in the death of the cells in the plant, without any relationship to the rootstock. The severity of the symptoms depends on the degree of tolerance of the tissue of the variety. The most sensitive varieties are the 'Pera' orange, the acid lime and the grapefruits.

5. With the exception of the State of Sao Paulo, efficient citrus certification programs capable of controlling the production and the propagation of propagative material do not exist. Although some states such as Minas Gerais, Bahia and Sergipe have implemented policies that attempt to control the movement of live citrus material, a great deal needs to be done to make these policies effective. There needs to be effective control of the movement of citrus products and sub-products between the producing and the consuming states.
6. Only three States have effective research and development programs.

Recommendations

- Considering the above mentioned opportunities and threats to the Brazilian citrus industry, we recommend that small farmers create cooperatives, associations of producers or organizations with the objective of bringing together the efforts of the government and the private sector in order to better serve the interests of the citrus industry. We believe that cooperation between all these entities will help the country realize the fantastic possibilities of the citrus industry in Brazil;
- We recommend state programs of research and development be established which emphasize the selection of cultivars for fresh consumption, diversification of rootstocks and post-harvesting;
- We recommend that state certification programs be set up to control the traffic of fruits and of propagative material between the producing states;
- We recommend that the government and private sector develop programs which strive to increase the consumption

of fruits and juice, especially in the younger generation. The Brazilian average for consumption of orange and mandarin fruits per capita is only 8.4 kg and 20.0 liters of orange juice respectively.

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Literature cited

Neves, M.F., Marino, M.K. ESTUDO da competitividade de cadeias integradas no Brasil: impactos das zonas de livre comércio. Campinas: Unicamp-IE-NEIT. 2000 Digitado

79 pág. Cadeia: Citros. Versão para discussão em Seminário. Nota Técnica Final.

FAO. 2003. Food and Agriculture Organization of the United Nations. (FAO homepage). Disponível em: <http://apps.fao.org/page/collections?subset=agriculture>. Acesso em: 25 mar. 2003.

IBGE. 2003. Instituto Brasileiro de Geografia e Estatística. Disponível: Site URL: <[http://www.sidra.ibge.gov.br/Produção Agrícola Municipal](http://www.sidra.ibge.gov.br/Produção%20Agrícola%20Municipal), 2001. Disponível em <<http://www.sidra.ibge.gov.br/cgi-bin/prtab>>. Acesso em: 25 mar 2003.

Passos, O.S. The Bahia orange: its place in the Citrus industry. California Citrograph 1979. p: 7-9.

Passos, O.S. A citricultura no mundo e no Brasil. Cruz das Almas - BA, EMBRAPA-CNPMP, 1990, 43 p (EMBRAPA-CNPMP Documentos, 30).