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RESEARCH AND THE NORTHEAST BRAZILIAN CITRUS INDUSTRY¹

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ABSTRACT – A review is made focussing on the influence of EMBRAPA's (Brazilian Enterprize for Agricultural Research) program on the development of the citrus industry in Northeastern Brazil, one of the poorest regions of the country. This region comprises almost 20% of the total land surface and almost 30% of the country's population and exhibits serious social and economic contrasts. Due to this extensive area (approximately 1,600,000 km²) and the large range of climates and soils, although the annual rainfall in almost 60% of the total area is less than 750 mm, the export/import balance is always favorable. Nevertheless, continually unbalanced growth between north and south has brought several social problems to the country as a whole. Recognizing this situation regarding the citrus industry in the 60's, where the citrus fruits of late ripening varieties that supplied the northeastern markets were exclusively from the State of São Paulo, and led by a citrus culture survey made in the Cruz das Almas area in 1961, a research program was started at the National Research Center for Cassava and Fruit Crops in order to improve varieties, extend harvest time and introduce certain cultural practices such as dense spacing. Ten years later a significant change could be observed – virus free and productive clones (nucellar lines) of late varieties like 'Pera' orange became preferred and close spacing (400 trees/ha) had been widely accepted. As a consequence of research results, regarding the mentioned aspects, almost 100,000 ha of citrus have been planted in the Northeast and especially in the States of Sergipe and Bahia.

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INTRODUCTION

The Brazilian Northeast is located between the parallels 2° and 18° S Latitude and between 35° and 42° W. The region comprehends the States of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia and the Federal Territory of Fernando de Noronha occupying 18.2% of the land surface. It has 42,822,000 inhabitants or 29.5% of the country's population as can be observed in the Figure 1 and in Table 1.



FIGURE 1. SIZE OF THE NORTHEAST REGION IN RELATION TO BRAZIL AND SOUTH AMERICA.

	South American	=	17,140,000 km ²	100%
	Brazil	=	8,510,000 km ²	49%
	Northeast region	=	1,540,000 km ²	18%

SOURCE: IBGE (1985)

TABLE 1 – Area and population of Brazil according to regions, 1990.

Region	Area (millions of km ²)	%	Population Urban	(millions) Rural
North	3.851	45.2	4.988	3.994
Northeast	1.556	18.2	25.001	17.821
Center-West	1.604	18.8	8.068	2.263
Southeast	0.924	10.8	57.910	7.648
South	0.575	6.7	16.775	5.987
Total	8.511	100.0	112.743	37.624

Source: IBGE (1989).

In this area, greater than that of some developed countries such as Germany, England, France and Japan, occurs a large range of climate and edaphic conditions which permit diversified utilization for agriculture.

TABLE 2 – Rainfall and land surface for successive vegetation types.

Vegetation	Rainfall mm	Area km ²	%
Forest	- over 1,000	510,000	31.9
Scrub	- 750 - 1,000	313,000	19.6
Savanna	- 500 - 750	591,000	36.9
Semi-desert	- 250 - 500	182,000	11.4
Desert	- - 250	4,000	0.2

Source: SUDENE (1985).

The climate is considered as humid tropical with an annual temperature mean varying from 23°C to 27°C and insolation of 2,300 hours/year in the humid areas to 2,800 hours in the dry areas - data of extreme importance for biomass production. In the "Drought Polygonal" (under 750mm) is situated more than half the area of the region but there are 82.0 million hectares with over 750m. Because of land availability and ecological conditions agriculture has a significant participation in the export volume, while in decreasing scale due to development of other activities, such as the petrochemical industrial park installed in the State of Bahia in

the 70's. In 1960, agricultural products contributed with U.S. \$206 millions or 83% of the Northeastern export total, rising to U.S.\$ 1 billion in 1983 or 45% of the total. While in the period 1975-83 the country presented a negative sum of almost U.S.\$ 4 billions in the export/import balance, the Northeast had U.S.\$ 8,5 billions as superavit. However, agricultural production has decreased its participation in the Gross Internal Product from 30.4% in 1960 to 14.3% in 1988 at a annual growing rate of 3.1% while industry and services had grown 6.2 and 8.1% respectively.

Although there is recognition of the important role of agriculture in the country's development, there remains a basic difference between the North and Northeast regions, on the one hand, and the Southeast region on the other. This is most markedly so in the case of the State of São Paulo, where there already exists a very competitive agriculture alongside a highly technified industrial sector. This is a largely responsible for Brazil's 8th position in world economic rankings.

The lack of a strong agroindustry sector in the Northeast accounts for many of the negative aspects of the region, such as: the migration of more than 5 million people from rural areas to the Southeast States, which is causing a very serious social problem; overpopulation in all the larger cities; underemployment in the urban areas estimated as 32%, as against a national average of 7%; the concentration in the region of 48.6% of those classified as poor, and of an estimated 68% of the rural misery where there are 23 millions of needy people.

The need for the development of this region on an agricultural base is more than clear. Agroindustry in the key for developing regions like the Northeast where there are land availability, suitable climate and soils and a high demand for agricultural products.

CITRUS RESEARCH

Headed by a survey conducted in the Cruz das Almas district in 1961, a citrus research program at IPEAL, today known as CNPMF/EMBRAPA, was started in order to seek solutions for problems which limited productivity. Relevant among the limiting factors was the genetic origin of the propagating material in more than 90% of the orchards. Due to the presence of virus disease the trees had a low productivity potential.

Taking this reality as a starting point, the research planned was especially related to genetic improvement and cultural practices. As soon as the first results were released through "Dias da Laranja" (field days) with direct collaboration of the State Extension Service and Banco do Brasil S/A, the data and the propagating material transferred showed better performance than that which had been used until then. Also through the State Committee of Fruit Crops, which gathers researchers, extensionists, teachers as well as the effective credit participation, the techniques began to be incorporated in orchards in different regions.

The booklet "How to grow citrus", a publication with a direct message to the grower, and the budwood of certified material were the vehicles of approach between the researcher and the citrus grower.

Through the introduction and distribution on new clones, superior to those formerly used, the program began to be utilized significantly by citrus growers, whereby the number of certified buds triplicated from 1967 to 1970, reaching the expressive number of 2 millions units as is shown in Figure 1. After 1972 citrus growers started to use their own budwood.

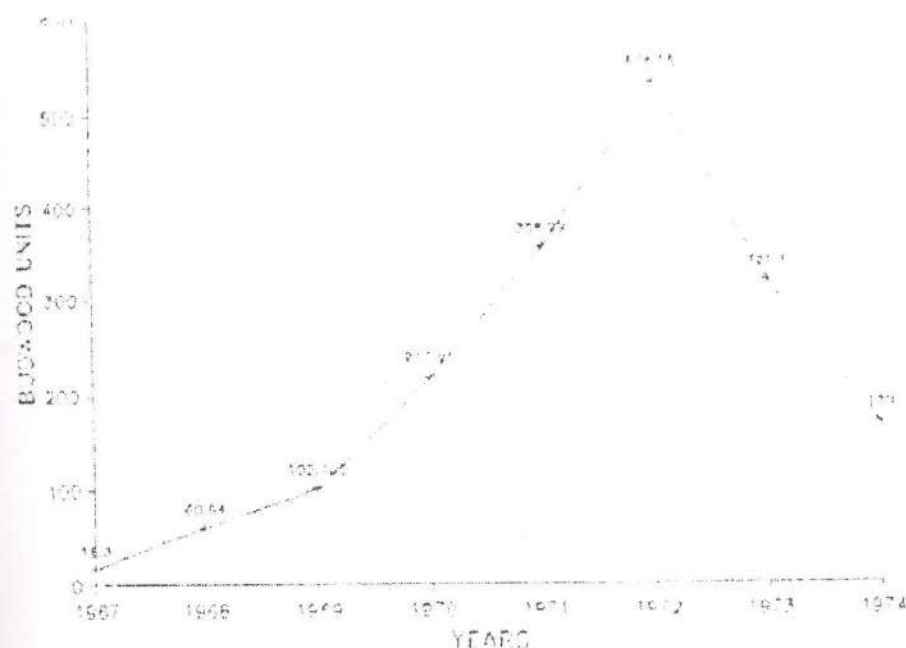


FIGURE 2. YEARLY PATTERN OF DISTRIBUTION OF BUDWOOD OF NUCELLAR CLONES (X 1,000).

At the same time, 12,000 trees of nucellar clones, some not yet used, were distributed to make possible the lengthening of the crop, which was previously concentrated in few months of the year with a resultant fall of fruit price on the market.

The superiority of the nucellar clone was observed through experimental trials with 'Bahia', 'Baianinha' and 'Pera' sweet oranges as is shown at Tabela 3.

TABLE 3 - Production (t/ha) of nucellar clone and old clones of 'Baianinha', 'Bahia' and 'pera' sweet oranges.

Variety	Nucellar Clone	Old Clone
Baianinha orange (4 years mean)	16.3	7.1
Bahia orange (4 years mean)	18.4	16.3
Pera orange (5 years mean)	26.3	6.3

This difference could be explained by the presence of exocortis viroid in 'Baianinha' trees, psorosis in 'Bahia', psorosis, exocortis and tristeza virus in 'Pera' trees.

From the survey conducted in 1961, it was observed that the tree density per hectare was approximately 200 or 7,0 x 7,0m and 6,0 x 6,0m spacing. An experimental trial comparing three spacings, among them the traditional 7,0m x 7,0m showed in 10 years of controlled study that in a more dense spacing of 7,0 x 3,0m the production was almost double that obtained at 7,0 x 7,0m (Table 4).

TABLE 4 - Production (t/ha) of 'Natal' orange under three spacings

Spacing	Production (t/ha)
7,0m x 7,0m	20.0
7,0m x 5,0m	25.1
7,0m x 3,0m	33.6

CITRUS INDUSTRY IN 1970

In 1970, a survey conducted in citrus orchards showed the following situation in the State of Bahia:

Cultivated area	2,800 ha
Number of trees	670,800
Nº of producing trees	420,000
Production	11,600 t
Mean production	5.9 t/ha

In Cruz das Almas, an area considered at that time as the most promising, the survey showed limiting and negative aspects such as the precominant use of 'Bahia' (Navel) orange (old clone), grafted only on 'Rangpur' lime as rootstock and planted at 7,0m x 7,0m spacing. A similar study was done in Sergipe in 1971 revealing:

Area sampled	1,997 ha
Nº of trees	448,524
Nº of producing trees	287,930
Production	11,000 t
Mean production	8.9 t/ha

The area which comprehends the districts of Boquim, Riachão do Dantas e Pedrinhas, considered the most representative, showed a predominance of 'Pera' sweet orange (old clone), grafted on 'Rough' lemon rootstock and planted at median density (5,5m x 5,5m).

A survey made in citrus orchards in the Cruz das Almas area in 1973 showed that the research was responsible for the propagation of nucellar clones in the proportion of 44% and that this propagation was effected after 1960 when this research program was initiated.

ACTUAL SITUATION OF NORTHEAST CITRICULTURE

According to IBGE Foundation the following was the orange performance in Brazil and the Northeast from 1960 to 1988.

TABLE 5 – Growth rate (%) of orange production, harvested area and yield in Brazil and the Northeast, represented by Sergipe and Bahia States (84,3% of the total region).

	1960/70			1970/80			1980/88		
	Brazil	Sergipe	Bahia	Brazil	Sergipe	Bahia	Brazil	Sergipe	Bahia
Harvested area	6.05	21.19	6.01	11.03	15.38	6.78	4.46	3.57	6.65
Production	6.37	16.48	6.78	13.39	25.36	8.09	4.33	4.34	5.52
Yield	0.29	-3.29	6.65	2.13	8.66	1.23	-0.12	0.81	0.05

In the decades 1970/1980 occurred the "boom" of the Brazilian citrus industry which has the State of São Paulo as the biggest producer, reaching 83.0% of the national production, but the highest rates were presented by the State of Sergipe especially regarding production and yield. Exactly in this decade the effects of research started to show. One can asseverate that the success of citrus research in Northeast areas was because it anticipated the phase of great culture expansion. The development of citriculture came after the recommendations obtained from a series of experimental trials and particularly those regarding scions, rootstock and spacing.

As in shown in Figures 3 and 4, the Brazilian citrus industry has been keeping an ascendent curve in the last two decades, which contributed to its first position in the rankings of international citrus producers. From 202,037 ha harvest in 1970, Brazil reached 880,356 ha in 1989 keeping a growth tendency. The State of São Paulo is responsible for 79.3% of the harvested area but citrus can be grown in any of the 27 Brazilian States. The Northeast region, although representing only 7% of the national production is the second producer with 70,756 ha, which is significant considering the lack of an adequate growth system in the country. According to unofficial data, Brazil, actually should have over 1 million hectares cultivated with citrus and approximately 100,000 in the Northeast (80,000 ha in the States of Sergipe and Bahia).

The orange production curve maintains a growth tendency as a consequence of an annual increase of cultivated area. In 1970 the production was 2,4 millions of tons or 5 times less than the total of 14 millions of tons produced in 1989. However, Northeast performance is superior when compared with Brazil as a

whole due to the State of Sergipe, that presented the higher growth rate particularly in the decade 1970 – 1980 (Figures 5 and 6).

Although Brasil is the world's leading orange producer, the yield continues very low: from 12.3 ton/ha in 1970 the yield rose to 16.1 ton/ha in 1988 which means less than 2.0 boxes (40,8 kg) per tree. Countries like the United States and Israel are producing more than double the Brazilian mean. In Figure 7 one observes a growth tendency from 1975 to 1985 with a fall thereafter except for the State of Sergipe, that continued on upward trend in the best fields.

Although the smallest State (21.994 km²) Sergipe is the second national citrus producer (700,000 ton in 1989) and has presented an expressive growth, with annual increments superior to 1.000 ha. As a consequence of this growth two concentrate juice plants were installed and are exporting to Europe and the United States. In 1989 it is estimate that there were exported 35,000 t of concentrate juice with a value of U.S.\$ 50 million. Beside the exports, which represent 60% of the total production, oranges as fresh fruits are being sent to North, Northeast and even to Southeast and Center-West in the States of Rio de Janeiro, Minas Gerais, Espírito Santo and to Brasília. According to unofficial data, in the State of Bahia and Sergipe there are more than 80,000 ha cultivated with citrus 90% of the total being with the 'Pera' D6 and D9 oranges (a clone from EMBRAPA).

In addition to this impressive sum it is worthwhile to consider also the direct and indirect hired labor, estimated in 100,000 people only in the State of Sergipe, and, moreover, the implementation of one more alternative for the Northeast which, two decades ago, was dependent on the Southeast, as the supplier of late maturing citrus fruits processed almost exclusively by the State of São Paulo.

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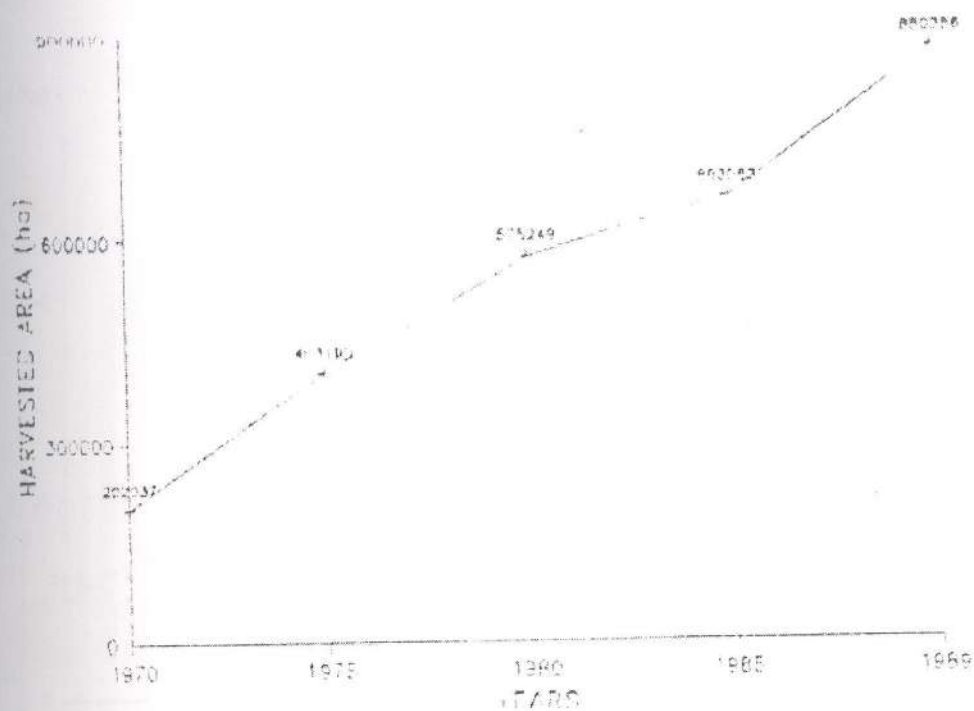


FIGURE 3. ORANGE: HARVESTED AREA (HA) IN BRAZIL.

SOURCE: IBGE (19/0/89)

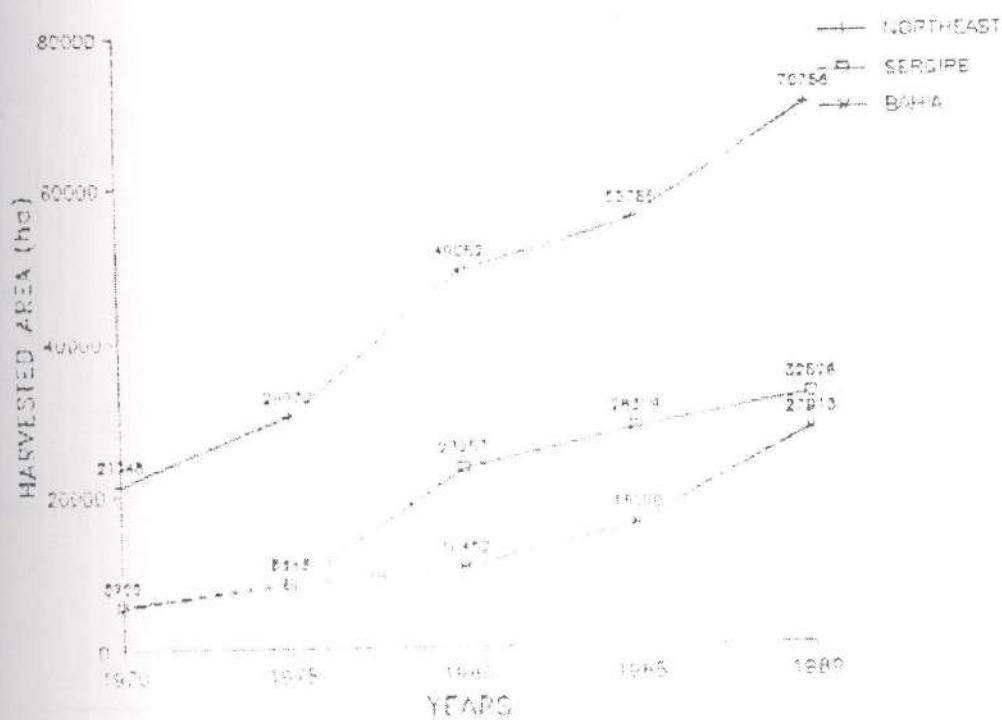


FIGURE 4. ORANGE: HARVESTED AREA (HA) IN NORTHEAST.

SOURCE: IBGE (19/0/89)

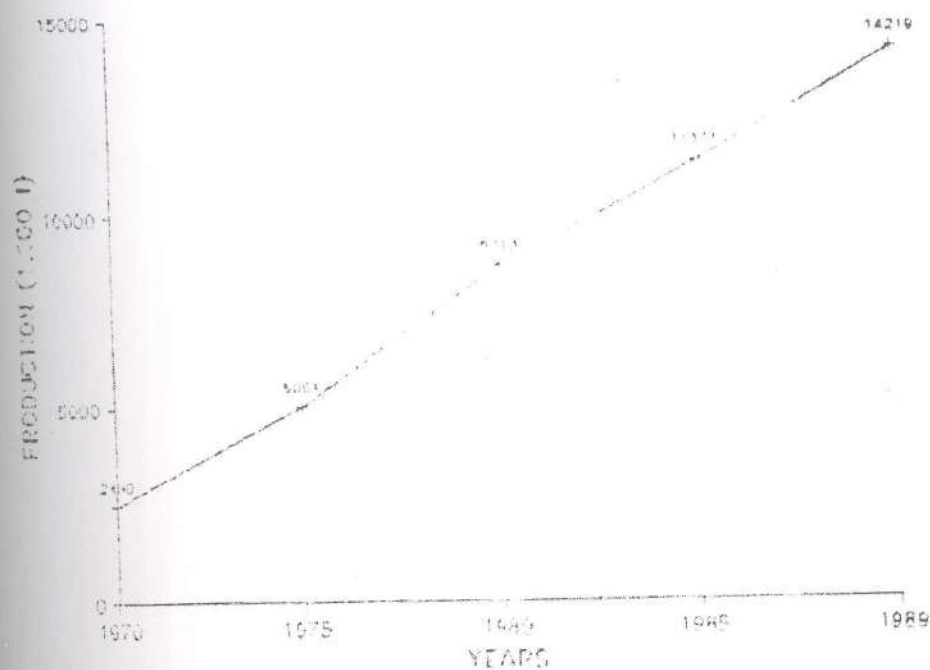


FIGURE 5. ORANGE: BRAZILIAN PRODUCTION (1,000 t)*.

SOURCE: IBGE (1970/89)

* FRUIT WEIGHT: 160 GR.

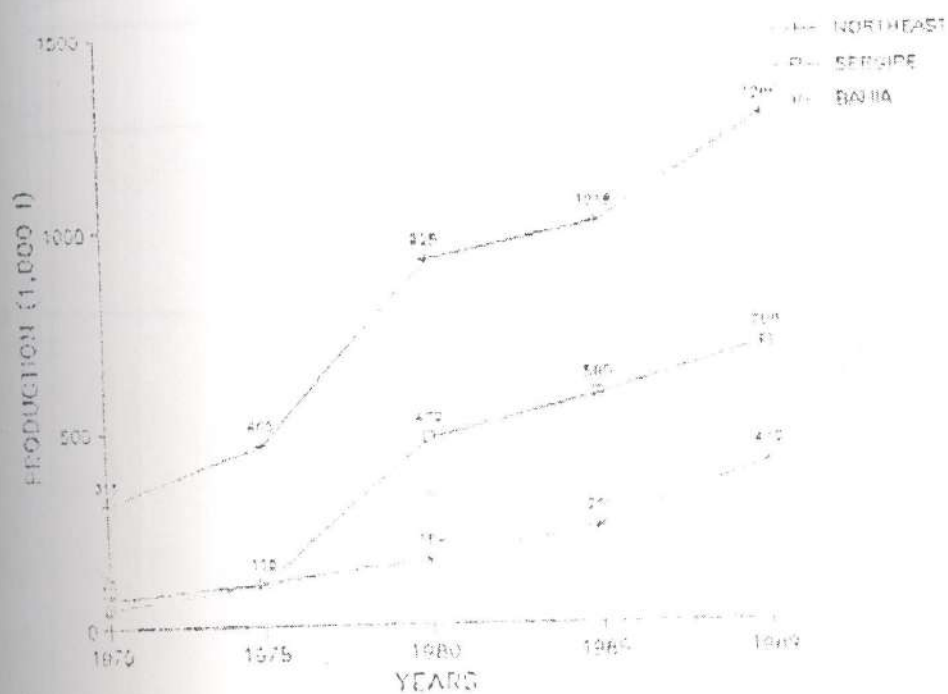


FIGURE 6. ORANGE: PRODUCTION (1,000 t) IN NORTHEAST*.

SOURCE: IBGE (1970/89)

* FRUIT WEIGHT: 200 GR.

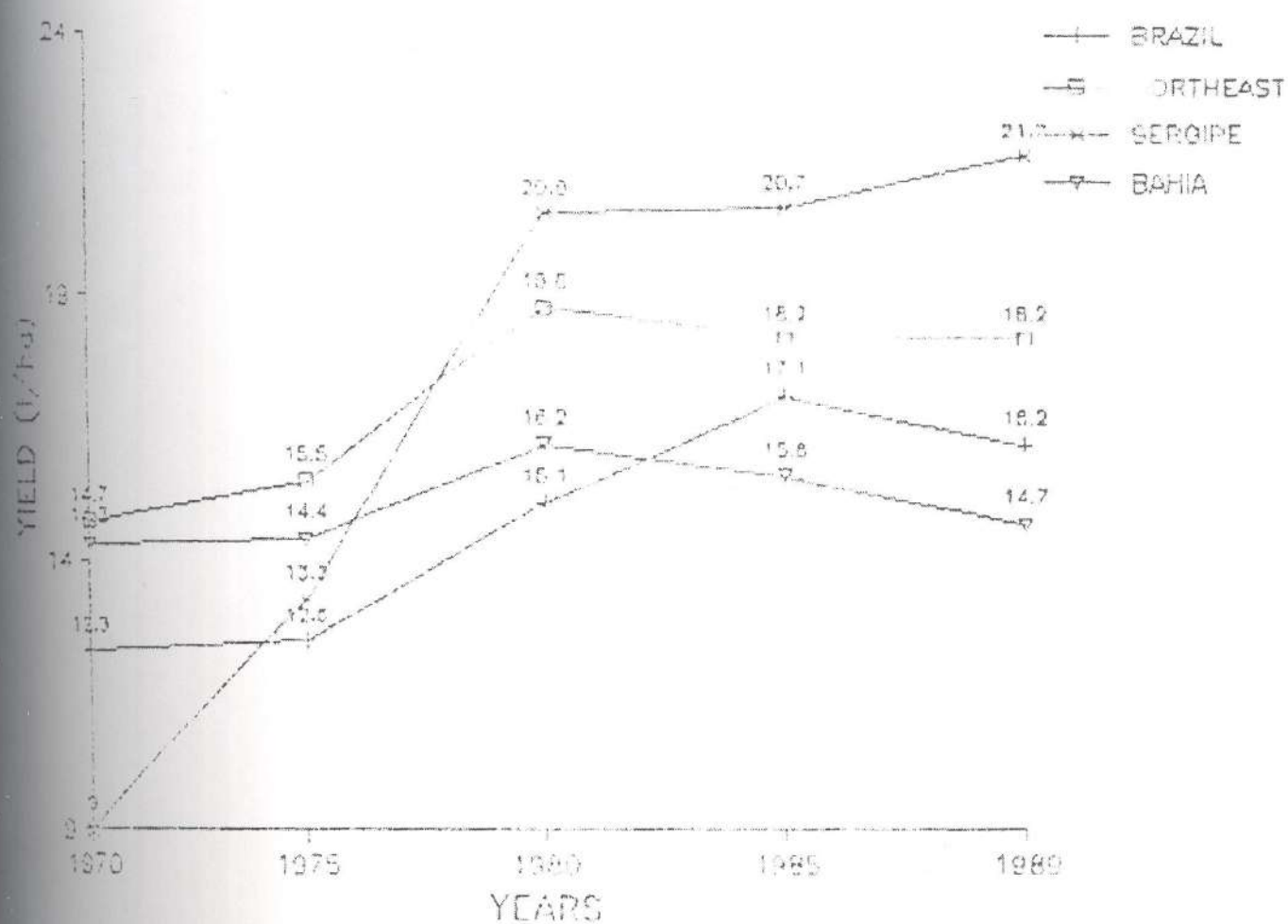


FIGURE 7. ORANGE: YIELD (t/ha) IN BRAZIL AND NORTHEAST.

SOURCE: IBGE (1970/89)