

The Carnauba Wax Palm (*Copernicia prunifera*).

II. Geography

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The natural distribution of carnauba in northeast Brazil is quite well known. To a large measure this is due to the ease with which it can be distinguished from other native palm species, for it alone has fan-shaped leaves. In such a situation, written accounts of the presence of carnauba in a given area can be used with greater assurance than is the case with many palm species.

The first comprehensive vegetation study of northeast Brazil was that completed by Luetzelburg (1922-1923). In it he included a map of natural vegetation formations and identified areas where carnauba was present. In 1935 additional data were provided by means of an aerial survey of carnauba stands led by H. F. Johnson, Jr. The manuscript map of carnauba distribution from the survey and reports of sightings taken from the literature were the basis for the distribution map of *C. prunifera* by Dahlgren and Glassman (1961). A modification of that map is presented in Figure 4.

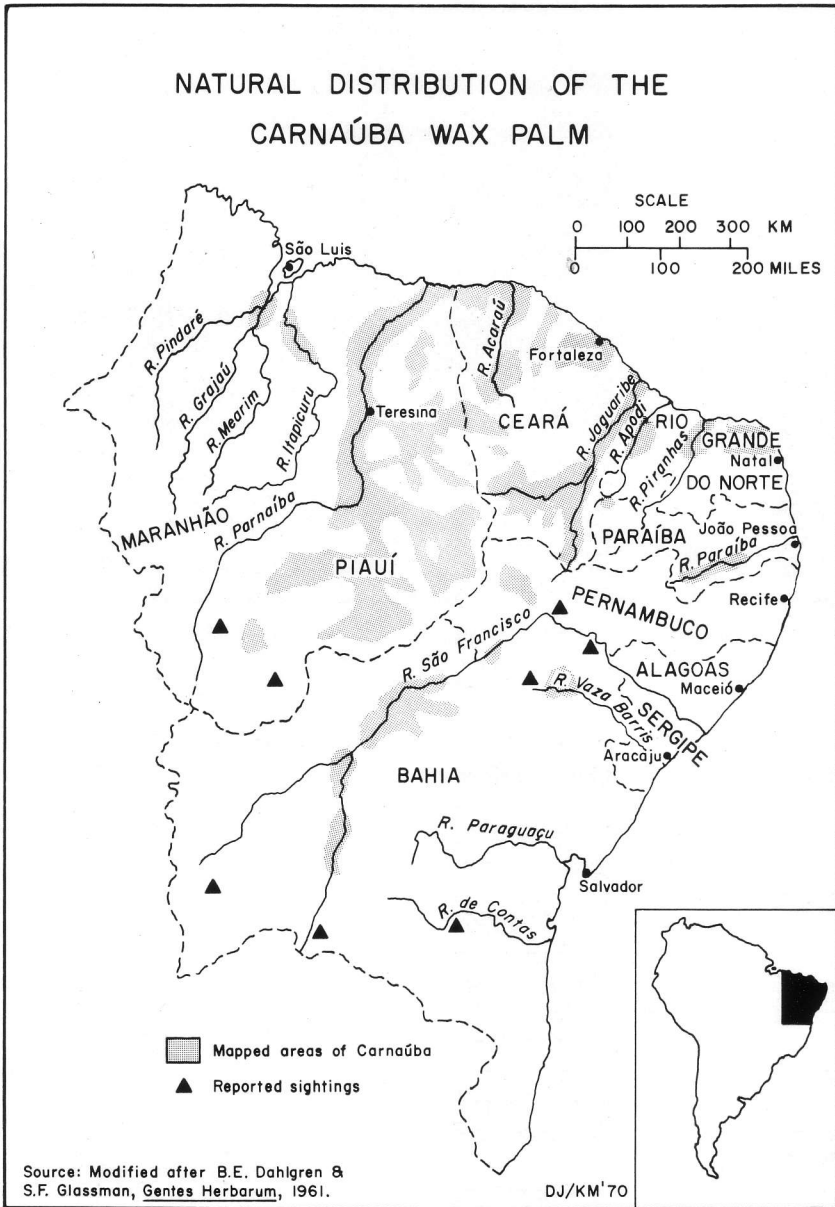
Ceará and Piauí are, as the map clearly shows, the core of the carnauba area; the states of Rio Grande do Norte, Maranhão, Paraíba, and Bahia accounting for the remainder. Reports of carnauba occurring elsewhere cannot be substantiated. The references to these palms being found in the Brazilian state of Mato Grosso, as well as in Paraguay and Argentina, are unfounded and refer to *C. alba*.

The question as to the number of specimens of carnauba growing in Brazil is often raised. Some idea of the numbers involved in the natural stands may be derived from a consideration of production statistics for the period 1936 through 1945. This is the period just prior to any significant plantation production, and is also a period of high carnauba wax prices which probably stimulated maximum exploitation. Over this ten-year period the average annual production was 10,550 metric tons. It is estimated that an average tree yields 100 grams of harvestable wax per year therefore suggesting that 105 million trees would have been required for that level of production.

Habitat

The harsh environment in which carnauba occurs is one that has precluded the growth of almost all other trees. Because of its size and the fact that it commonly occurs in pure stands, the species gives a very distinctive appearance to the local scenery. This is especially true during the dry season when the deciduous shrubs and low trees of the *caatinga* or thorn forest are without leaves. That the carnauba is able to survive the long dry season without any seeming inconvenience is a matter of both pride and wonder to the residents.

Climate. The climate over the area under discussion can be described as hot



4. Natural distribution of the carnauba wax palm.

and semiarid. Temperatures remain high the year around, making the amount of precipitation the critical factor limiting plant growth. Annual rainfall averages

vary widely, from over 75 inches in the area of São Luís, Maranhão in the north, to under 15 inches in the Rio São Francisco Valley in the south. The dry and



5. Carnauba palms can tolerate extended periods of partial submergence. Photo courtesy S. C. Johnson & Son, Inc.

wet seasons are very distinct, and this has led to the rainfall regime being described as "flood-drought."

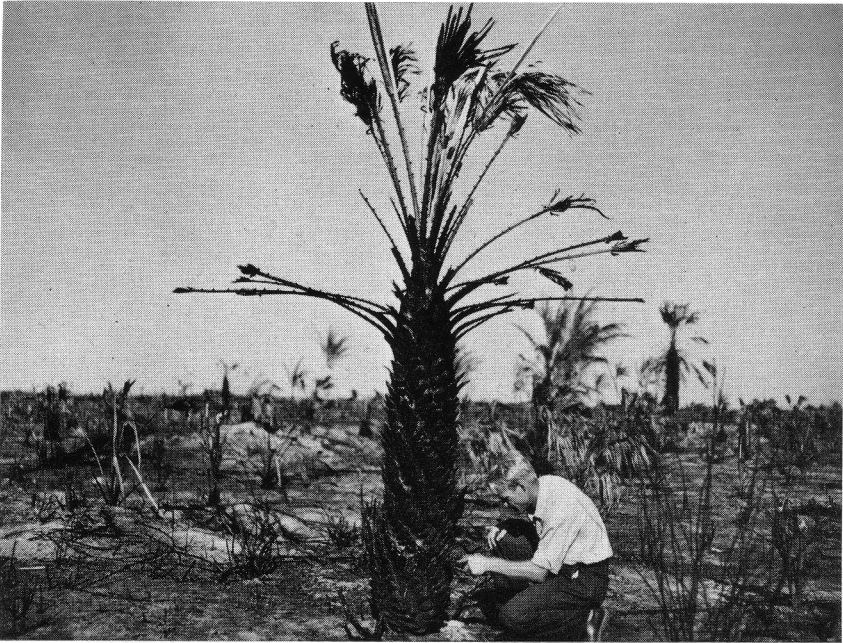
The carnauba is very closely adapted to this native habitat as far as temperature is concerned; it has no frost tolerance. This was well exemplified in 1962 in Daytona Beach, Florida, where seven species of *Copernicia* were being grown. All were subjected to a hard freeze with temperatures below 30°F. for three consecutive nights. The *C. prunifera* was killed outright, while other species suffered some frost damage but recovered (Smith, 1957, 1964).

Topography. The distribution pattern in Fig. 4 shows a concentration of carnauba palms in river valleys. In altitude, these valleys range from sea level to nearly 1,500 feet. There are a few coastal areas where environmental conditions found in the river valleys are almost duplicated in terms of soils and annual flooding, and which support extensive

carnauba stands. This is the case in northern Piauí and Ceará, between the Rio Parnaíba and Rio Acaraú, and also in the general area around Fortaleza.

The river valleys of the northeast, especially those of the north coast, are broad and have extensive floodplains. Wide areas remain submerged for a few months of each year during the rainy season. The palms there appear to be little affected by such flooding. There are reports of carnauba palms that have been partially submerged for a number of years due to the interruption of normal drainage by roadbuilding (Fig. 5).

Soil. On the floodplains where carnauba occurs, Gomes (1945) found that in the lowest portions of the valleys, sandy-clay soils predominated; toward the edge of the floodplain the proportion of clay increased until it became dominant. The carnauba favors the deep alluvial soils near the main channel of the river, and decreases in number as the



6. Example of burned carnauba palm which recovered and produced harvestable leaves the following year. Photo courtesy S. C. Johnson & Son, Inc.

amount of clay in the soil increases. The generalization is also made that the soils of the north coastal plain are of a clay-sand mixture favorable to the growth of carnauba.

Fires. Northeast Brazil is similar to a savanna grassland area in that fire is a significant ecological factor. The carnauba appears to be well adapted to these conditions as well. The degree of burning to which it can be subjected and still survive is dramatically shown in Fig. 6. The plant recovered completely and leaves were harvested from it the following year.

The residual leaf bases of the carnauba may serve as protection against serious damage by fire, in addition to functioning as water-storage tissue (Fig. 7). Young plants not yet protected by a trunk of these attached petiole-bases are quite easily killed by fire.



7. Cut through an old attached petiole base exposing living tissue. Photo courtesy S. C. Johnson & Son, Inc.

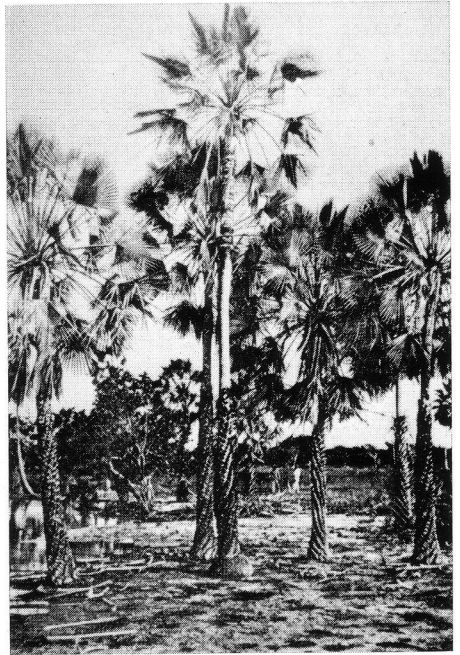


8. Natural stand of carnauba near Fortaleza, Brazil.

Vegetation Associations

Modern vegetation maps of Brazil generally give a separate designation to the river valleys where carnauba predominates. The term "gallery forest" is often used, and an examination of aerial photographs or an airplane flight over the area supports this designation. The carnauba stands in general are pure although comparatively sparse. An aerial view of a natural stand in the Rio Cocó Valley near Fortaleza is presented in Fig. 8. A close-up view of a stand in the Rio São Francisco Valley taken more than 60 years ago is also presented in Fig. 9. The palms in the latter picture exhibit luxuriant crowns indicating that they were not being harvested for leaves.

Annual flooding eliminates competition from most other tree species as well as undergrowth, allowing the carnauba to be dominant in the river valley sites. The importance of annual flooding in keeping out other plant species is very evident when this palm is grown away



9. A stand of carnauba along the Rio São Francisco, Brazil. From Karsten and Schenck (1908).

from the flood plains on plantations, for control of brush is a major problem.

While carnauba predominates on the flood plains, it is by no means the only tree found there. Three other evergreen trees are commonly found bordering the carnauba stands on either side of the valley and usually occur in association with a growth of underbrush. These are the *juazeiro* (*Zizyphus joazeiro*), *quixaba* (*Bumelia sertorum*), and *oiticica* (*Licania rigida*). The latter is economically important as a source of drying oil derived from its seeds.

In Maranhão and Piauí, the carnauba occurs both in river valleys and in coastal areas subject to flooding, while on the sites above high water the *babaçu* palm (*Orbignya speciosa*) is dominant. The *babaçu* represents another important resource of the region because of the valuable edible oil its seeds contain. These two palm species form what is termed a transitional zone between the tropical rainforest of the Amazon Basin and the thorn forest of the northeast; the designation "palm forest" has been applied to this particular formation.

Foreign Introductions

The historical geography of economic plants is replete with interesting accounts of proposals which might well have altered the present list of major tree crops. Carnauba is no exception. The rise in industrial importance of carnauba wax around the turn of the century, during the same period in which rubber was successfully taken out of Brazil and established as a plantation crop in Southeast Asia, led to speculation that carnauba might possess similar potential. The following information on carnauba introductions was obtained through personal communication except where otherwise noted.

Beginning in the nineteenth century the carnauba was introduced to a number

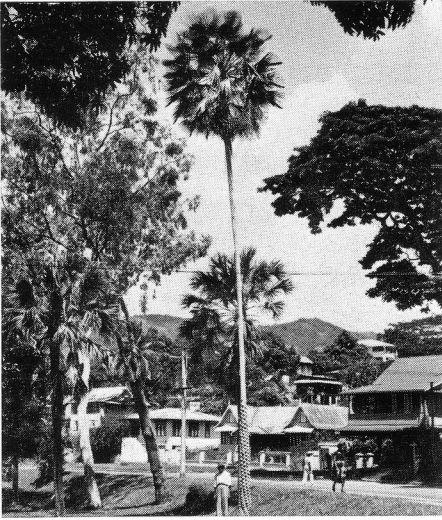
of locations and grown in botanic gardens. Within Brazil, it was taken to botanical gardens in Rio de Janeiro and Belém. Outside Brazil, the first recorded introduction took place sometime in the mid-nineteenth century, for the palm is on an 1863 plant species list of the Royal Botanical Gardens in Mauritius. Details concerning the introduction are not available, which is not surprising since carnauba does not appear on a 1938 species list for that garden.

Ceylon appears to have been the second location to receive carnauba seed, with some coming from a private source in 1882.

The Kew Gardens was involved in the largest documented distribution of carnauba seed. This came from the British Consulate at Recife, Brazil, which shipped a large bag of seed to Britain in 1889. That same year the Kew Gardens distributed five-pound packets of seed to 18 locations around the world. Information on these seed shipments was sought from the respective botanical gardens and institutions. Ten replies were received but only Ceylon had a record of having received their shipment.

The Singapore Botanic Garden could provide no information on the 1889 shipment, but it is known that they received carnauba seed from some other source in 1902 (Burkill, 1935). Although the Trinidad Botanic Garden could likewise provide no record of the seed shipment, a case may be made that it was successful. A photograph taken in 1952 of a carnauba at the St. Clair Research Station, which is adjacent to the botanic garden, shows a tree which at that time was reported to be over 50 years old (Fig. 10). This fine specimen could well represent a successful germination from the 1889 seed shipment.

In subsequent years the record of introductions becomes more difficult to follow. It is known that 25 kg. of seed



10. Carnauba palm at St. Clair Research Station, Port-of-Spain, Trinidad. Photo courtesy S. C. Johnson & Son, Inc.

were received by the Institute of Biology and Agriculture at Amani, Tanzania (Tanganyika) in 1907 and successfully germinated. The intention was to establish the palm as a plantation crop for wax (Zimmermann, 1906, 1907). In the same period a German seed merchant undertook to promote carnauba planting both as a source of wax and as a shade tree for other crops such as coffee or rubber (see *Tropical Agriculturist*, 41: 527. 1913). World War I, however, intervened before these schemes could be carried forward.

In the 1920s the Dutch gave some consideration to carnauba as a plantation crop in Java, but again nothing tangible appears to have been done (Heyne, 1927).

Within the United States there are records of several recent introductions. Carnauba was taken to Hawaii in the 1930s and there has become a popular ornamental. The U.S. Plant Introduc-

tion Garden, Miami, Florida, has had several introductions, the first in 1936. The Fairchild Tropical Garden, also in Miami, received their first carnauba seed in 1937. A number of specimens from these introductions are presently in the collections of the two gardens.

Any of the introductions into areas of favorable climate could potentially have led to the establishment of this species as a plantation crop, but there is no evidence that such an attempt was actually made. It appears that there has never been sufficient world demand for carnauba wax to support such a venture, and the carnauba has remained economically important only within its native area.

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