RACES OF MAIZE IN VENEZUELA

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NATIONAL ACADEMY OF SCIENCES—
NATIONAL RESEARCH COUNCIL

Publication 1136

COMMITTEE ON PRESERVATION OF INDIGENOUS STRAINS OF MAIZE

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Funds were provided for this publication by a contract between the National Academy of Sciences—National Research Council and the Agency for International Development, formerly the International Cooperation Administration. The grant was made for the work of the Committee on Preservation of Indigenous Strains of Maize, under the Agricultural Board.

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Publication 1136
NATIONAL ACADEMY OF SCIENCES—
NATIONAL RESEARCH COUNCIL
Washington, D. C.
1963

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Price $2.00

ACKNOWLEDGMENTS

This study represents a joint effort by the Colombian Government, The National Academy of Sciences—National Research Council, and the Rockefeller Foundation. The study would not have been possible without the generous support of the various officials of those organizations.

It would be extremely difficult even to list all the persons who contributed to the successful completion of this project. But to all these people—and foremost are the Venezuelan farmers who allowed their corn to be collected—the authors are indebted and deeply grateful for their helpfulness.

Many Ingenieros Agrónomos deserve special mention for helping to collect data for this report. Ing. Agr. Ricardo Ramírez E. generally supervised the collection of the plant and ear data. Ings. Agrs. Bertulfo Peña V., Javier Gómez J., Efraín Díaz B., Daniel Sarria V., Fernando Arboleda R., Efraín Alvarado C., Manuel Torregroza C. and Daniel Varela A., all had a part in collecting, evaluating, and summarizing the contents of this study and without their dedicated help it would have been impossible to complete this task.

Many students at the Facultad de Agronomía at Medellín helped collect the data on the external characters of the ears of the original collections.

Ing. Luis E. Castiblanco G. and Sr. Luis Mahecha T. helped to tabulate the ear and plant data. The distribution maps were prepared by Srs. Víctor M. Pinzón R. and Hector H. Escobar L. Sr. Terencio Rengifo H. photographed the typical ears and the charts and diagrams.

Sr. Victor Manuel Patiño R. was the principal collector of Venezuelan maize. The excellence of the collection is due primarily to his diligence and knowledge of maize as well as to his understanding of the people who grew it and his ability to communicate with these people. Sr. Patiño was ably assisted by Srs. Pascual Aguirre and Alfredo Rivas. Sr. Pablo E. Daza B. received, catalogued, and stored the collections and helped greatly in organizing materials for study.

We are indebted to Mrs. W. H. Hatheway who typed the first draft of the manuscript and to Srtas. Cecilia Acosta and Filo Cubillos who prepared the final draft.

Srtas. Eloisa Rivera E. and Elvia Quintero A. assisted generally throughout this study. Their help was indispensable in completing hundreds of details connected with this work.

We are grateful to the Committee on the Preservation of Indigenous Strains of Maize of the National Academy of Sciences—National Research Council for their help in editing this publication. For the Spanish edition we are indebted to the personnel of the publications office of the Department of Agricultural Investigations of the Colombian Ministry of Agriculture.

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RACES OF MAIZE IN VENEZUELA

This is the fifth in a series of monographs on the races of Andean maize prepared by the maize workers in Colombia. The first of these bulletins, *Races of Maize in Colombia* (Roberts *et al.*, 1957) was very largely a response to an urgent local need. In 1950 the Colombian Ministry of Agriculture and the Rockefeller Foundation jointly initiated a program for improving the country's basic food crops. One of the first projects was a corn-breeding program and it was soon evident that a thorough collection of local types of maize was needed.

Two full-time collectors traveled throughout Colombia and assembled nearly 2,000 collections of maize. A classification of this material into races was found desirable, as it had been earlier in Mexico (Wellhausen *et al.*, 1952). The monograph on Colombian maize was an outgrowth of this work, the primary purpose being to gather and evaluate improved material for a corn-breeding program.

Subsequent monographs (Ramirez *et al.*, 1960; Timothy *et al.*, 1961; Timothy *et al.*, 1963), have not developed out of such urgent local needs but rather with the idea that valuable maize germ plasm should be collected and preserved for future use. Soon after the Colombian collection had gotten under way, the National Academy of Sciences—National Research Council of the United States became interested in preserving indigenous strains of maize in the entire hemisphere. Arrangements were made by the Academy-Research Council to supplement the seed centers already established in Mexico and Colombia by establishing one in Brazil. It was decided that the Mexican center could serve that country, Central America, and the Caribbean. The center in Colombia could serve Colombia and the other Andean countries, and Brazil could collect and preserve the maize of eastern South America.

The collection center at Medellin is cooperatively maintained presently by the Colombian Ministry of Agriculture, the Rockefeller Foundation and the Academy-Research Council. Collections which now number 5,989 have been made in Colombia, Bolivia, Chile, Ecuador, Venezuela, and Perú. Monographs describing the collections of all of these countries are now complete.

In the studies of the maize of Ecuador, Bolivia, and Chile, emphasis has been placed on the role of maize in the traditional way of life of the inhabitants of those countries. The populations of highland Bolivia and Ecuador, for example, are still very largely Indian, and ancient customs have not been altogether lost. The races of maize described have thus included unusual types such as dye-corns, sweet corns used in preparing superior grades of *"Chicha,"* a fermented drink made by the highland Indians of South America, and extraordinary varieties adapted to very high elevations or to clearings in the Amazonian forests. Maize grows in the Andean Region at elevations over 12,500 ft. (above Lake Titicaca in Perú) to sea level and from areas with less than 10 inches of rainfall such as the Guajira Peninsula of Colombia, to over 400 inches in the department of Chocó on the Pacific Coast of Colombia. Practically every known plant, grain, and cob color, and undoubtedly many as yet not studied, have been found in the Andean collections. These are corns which have not yet been swept away by the impact of modern civilization. Doubtless many types would soon be extinct except for the germ-plasm banks in Mexico, Colombia, Brazil, and Fort Collins, Colorado, where duplicate samples of the collections are maintained.

The history of most maize in Venezuela is somewhat different. The coastal areas of Venezuela are filled with bustling modern cities with attendant oil wells, iron mines, and superhighways. Maize-breeding programs have been carried out in Venezuela for over 20 years; outstanding varieties have been developed there which have been used extensively in many countries. The variety Venezuela 1, developed by Dr. D. C. Langham and co-workers, for example, has been recommended to corn growers in the low elevations of Colombia by their Ministry of Agriculture. The local unimproved varieties of maize of Venezuela are in many cases outstanding sources of germ plasm for the plant breeder. The Caribbean Yellow Flint complex possesses excellent characteristics and is the dominant type of lowland Venezuelan maize. The variety *Sicarigua,* which is basically the same as the *Tuxpeño* race of Mexico, is high-yielding and gives good material for maize improvement. Puya Grande has an exceptionally long ear and has been used to improve the coastal corns which generally have a very short ear.

If in this monograph, therefore, we stress the economic importance of Venezuelan maize, we do not wish thereby to minimize the values of the ethnobotanical approach where that is possible and appropriate. Our emphasis merely reflects our conviction that in Venezuela maize is an important economic plant in a changing modern economy.

GEOGRAPHY OF VENEZUELA

The topography of Venezuela is dominated by two outstanding features. The broad Orinoco River bisects the country into a populous northern half and an essentially uninhabited forested southern region. The Andean Cordillera subdivides the northern part of the country along a southwest-northeast axis. It ends in Venezuela only after reaching impressive snow-capped heights in the western state of Mérida. Our collections of Venezuelan maize are essentially restricted to the part of the country lying north of the Orinoco.

Figure 1 is a map of northern Venezuela in which areas over 500 meters in elevation are shaded. The principal geographical feature is the broad valley of the Orinoco and its western tribu-

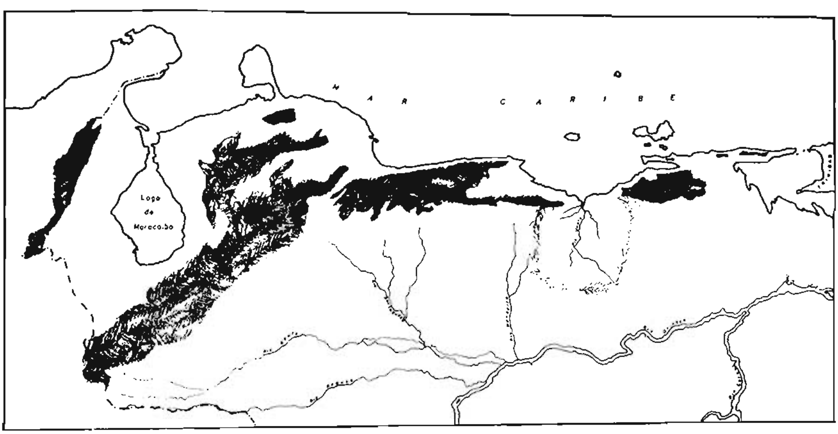

FIG. 1. Map of Venezuela.

taries, the Cojedes, Apure, and Arauca Rivers. These western lowlands border on the Colombian Llanos, and like the Llanos, they are sparsely inhabited grasslands in which cultivation of the land has always been limited. To the east lie the mouths of the Orinoco, forming a vast swampy delta ecologically unsuitable for human population. Among the lowland areas of Venezuela there are the regions around Lake Maracaibo, the narrow northern coastal plain, the eastern State of Monagas, and the Urare Valley of the States of Guarico and Anzoateguí. All are important areas of maize cultivation.

At intermediate altitudes, especially along the southern flank of the Cordillera, several commercially important types of maize occur. *Tuxpeño* and *Puya Grande* are the dominant types, but *Blanco Común* and *Costeño* are also found in this area. This zone, which may be termed the maize belt of Venezuela, runs through the States of Barinas, Portuguesa, Cojedes, Yaracuy, Carabobo and Aragua at elevations of 200 to 800 meters.

The races of maize cultivated at elevations up to 3,000 meters in Mérida and Táchira in western Venezuela are specialized or relict types, apparently related to the Andean maize of Colombia. *Pollo*, for example, is an early, low-yielding semi-pop which differs from its Colombian counterpart only in the extent of introgression from other Venezuelan races. *Sabanero* almost surely has the same origin as the *Sabanero* race commonly found at high altitudes in Colombia. Other races such as *Puya Grande*, *Puya*, *Cuba Yellow Flint*, *Costeño* and *Común* are found commonly in similar areas of latitude and elevation in the two countries.

VENEZUELAN INDIAN GROUPS AND THEIR AGRICULTURE

Knowledge of the Indian tribes of Venezuela, as well as of the other circum-Caribbean groups of Colombia, adjacent Central America and the West Indies, is generally fragmentary (Steward, 1948). Their coastal homelands were easily accessible to the Spanish conquerors, their population declined rapidly, and today they have been largely replaced by descendants of the Europeans and the Negro slaves who were imported as laborers. Only small groups of Indians remain now, and even these are for the most part culturally and racially much modified.

In contrast to the rich literature concerning the Spanish conquests of Mexico and Perú, the chronicles of the Caribbean coast of South America are meager and disappointing. Archeological remains are apparently fairly common, but few have been intensively studied (Osgood and Howard, 1943; Kidder, 1948). What has been learned from the early chronicles and archeology, however, demonstrates conclusively that very little of the more advanced culture of the coastal Indian tribes remains among the scattered remnant and refugee groups of today.

The same fragmentary evidence suggests, moreover, that the culture of the coastal tribes was by no means insignificant, although of course, it was much less advanced than those of Mexico and Perú. There were large fortified villages, especially in western Venezuela, and the technology included weaving, gold metallurgy, and ceramics. East of Caracas, however, small villages, some consisting of only five or six houses, seem to have been the rule (Latorre, 1919; Kidder, 1944). The coastal tribes grew many crops which are still important in the American tropics: manioc, maize, sweet potatoes, cucurbits, beans, many fruits (notably pineapple and papaya), and cotton and tobacco (Pittier, 1932). Hunting and fishing were extremely important in the economies of the Indians of lowland Venezuela. The Arawak and the Carib were skilled coastal seafarers, and water-borne commerce was carried on in foodstuffs, salt, gold objects, and slaves.

Before the Spanish conquest Arawakan-speaking tribes extended from coastal eastern Colombia along the Caribbean as far as Lake Valencia and the Caracas River and south to the present states of Barinas, Portuguesa, and Cojedes (Steward, 1950). Other Arawakan groups occurred in the Greater Antilles, the Guianas, and scattered through the forests along the eastern slopes of the Andes as far south as Paraguay (Steward and Faron, 1959). *Maiz Chandelle* and *Tusón* (Brown, 1960; Hatheway, 1957) and other types of Cuban and Haitian maize are also found in eastern and central Venezuela. It seems probable that the Arawak introduced them to the Antilles from northern South America. It is somewhat surprising to find only yellow maize in the West Indies

(Brown, 1960), whereas white and yellow forms, including *Maiz Chandelle,* are common in many coastal races of the mainland.

Between the Caracas River and the Delta of the Orinoco and extending up the Orinoco, were a number of Carib-speaking tribes (Acosta Saignes, 1946). Like the Arawak, the Carib were widely distributed in the tropical forests, although their largest concentrations were north of the Amazon. Aggressive, warlike, and often cannibalistic, they displaced Arawakan tribes from parts of Venezuela and the Lesser Antilles shortly before the Spanish conquest (Jahn, 1927; Rouse, 1948). The maize of the areas of Venezuela formerly dominated by Carib-speaking peoples—chiefly the present states of Sucre, Anzoateguí, and Gúarico —is distinctive. The grains of the races *Canilla Venezolano, Guaribero,* and *Chirimito* are often small, hard, round (when seen from above) and wedge-shaped, and their arrangement is tessellated. They resemble some of the *Guaraní* races (Brieger *et al.,* 1958) and, more remotely, the interlocked races of Amazonian Bolivia and Perú, such as *Coroico, Enano, Pororó,* and *Pojoso* (Cutler, 1946; Ramirez *et al.,* 1960; Grobman *et al.,* 1961). The soft flour corn *Cariaco,* which resembles certain white soft corns of Brazil, also seems to have been used by the coastal Carib.

Since the Venezuelan Andes are a continuation of the Cordillera Oriental of Colombia, it is not surprising to find similarities between the cultures of the highland Chibcha of Colombia and the Timote of western Venezuela. The latter built water storage tanks and irrigation systems (Metraux and Kirchloff, 1948; Steward and Faron, 1959) and practiced a diversified agriculture based largely on potatoes and other tubers as well as maize. The highland maize varieties of Venezuela, including the distinctive primitive race *Pollo* (Roberts *et al.,* 1957), are obviously related to those of Andean Colombia.

The Venezuelan Indians used both bitter manioc and maize as bread. Bitter manioc was ground, mixed with water, and strained to remove the poisonous principle. The dough was then baked on hot stones or bricks (Gumilla, 1791). The manioc tortilla was an almost universal staple in the Venezuelan tropics at least until the latter part of the eighteenth century. The "bread" made from maize, as Padre Gumilla described it, was quite a different preparation. Corn meal (ground with a wooden mortar and pestle, not a metate) was wrapped in leaves and boiled. This corn meal was either eaten immediately or converted to chicha (corn beer). In the latter case, it was allowed to dry and become somewhat mouldy, after which it was crumbled, mixed with water and allowed to ferment for about three days in large jars. Maize also was very commonly eaten in the immature stage, as a delicacy.

A unique maize bread was prepared by the Otomaco of the middle Orinoco Basin (Gumilla, 1791; Howard, 1943; Kirchhoff, 1948). Grains of maize or other starchy foodstuffs were mixed with clay and buried for a few days until they began to ferment. The mixture of starch and clay was then stirred with water in large jars and allowed to settle. The water was next poured off and large quantities of turtle or alligator fat were added to the sediment. From this dough, small, round loaves were shaped and baked in ovens.

According to Gumilla, this Otomaco "bread" had the appearance and consistency of well-cured brick.

MODERN MAIZE CULTIVATION IN VENEZUELA

There is little doubt that maize has played an important part in the development of Venezuela and certainly the main food of the marauding Caribs and other indigenous tribes was maize consumed green, parched, popped or in other ways. Maize is still used as a basic food by the Venezuelans in all parts of the country and at all elevations. A crop of corn can be produced at sea level in approximately four months while a crop may take as much as thirteen months to develop at elevations near treeline, as is the case around the world at latitudes near the equator.

Maize is produced throughout Venezuela (see Table 1, Appendix), the leading corn producing states being Portuguesa, Zulia, Guárico, Anzoateguí, Cojedes and Falcón. The yield per area is relatively low with an average production of about 1,200 kilos per hectare in 1958 (approximately 20 bushels per acre).

The utilization of corn is predominantly for direct human consumption. Many variations of the "arepa," a bread prepared from "maiz pilado" (grain with the pericarp and embryo removed by a mechanical process), are eaten by the population. Various soups, hominy, flat cakes, porridge, and maize pastes are used in the diet, and large quantities of roasted ears and boiled corn (choclos) are eaten green especially in and around the larger cities. As is the situation throughout most of the Andean Region, maize is considered the most important basic food crop by the rural people.

UTILIZATION OF MAIZE FROM THE GERM-PLASM BANK

It would be tragic indeed if the variation in maize which has evolved over thousands of years were to be lost. Therefore, much effort has been made to see that the maize germ plasm from the entire hemisphere is preserved for future use. With increased emphasis on maize breeding in most of the countries, and with improved varieties and hybrids rapidly becoming available for most of the area, it is probable that many of the primitive types will become mixed or lost altogether within a few years.

The material from the germ-plasm bank is now generally available to maize workers all over the world. Brown (1960) has described the use of maize from the West Indies in breeding programs in various countries. Presently many other examples can be cited where valuable types from the Andean Region are being utilized. Breeding materials from Venezuela have been used extensively in the Colombian maize-improvement program. Colombian varieties and hybrids such as Eto and Diacol H-203 contained material from Venezuela, and the more recent hybrids are utilizing lines developed from the Caribbean area.

Storey (personal communication) reported that the variety Colombia 2 furnished exceptionally high resistance to corn rust, *(Puccinia polysori)* in Kenya. Other breeding materials adapted to the Colombian high and medium elevations have been useful in Rhodesia and Ethiopia.

Lines developed in Colombia have been used in hybrids in Brazil and these hybrids have been exceptionally high-yielding in comparison to local types.

Most of the countries of Central America, where flint corn is desired, have found such varieties and hybrids as Eto Blanco and Diacol H-251 to be exceptionally useful in their medium and low elevations. Lines developed in Colombia from collections made in the Caribbean Region are being used in hybrids in the Philippines and India. This indicates that much of the maize from the Caribbean, particularly the *Cuba Yellow Flint* race, has wide adaptation and is extremely valuable for use as breeding material around the world at latitudes of 30° or less. It has been noted too that there is a compensation between latitude and altitude. For example, maize adapted to 1,500 meters at 6° N. latitude in Colombia can be moved north or south to 25°- 30° latitude if it is used at lower altitudes. However, this relationship is not a simple one and requires additional study before generalizations can be made.

Fortunately, the collections have been finished and this bulletin completes this series on the races of maize from the Andean Region. However, more work remains to be done in screening this material for valuable genetic characters, disease and insect resistance, and other characters of value to geneticists and plant breeders. There is no doubt that the Andean collection contains much material of value in helping to reach a new level of yield in maize in various countries of the world. Every effort will be made to keep the collections viable until they can be thoroughly gleaned of all valuable characters.

If this information can be catalogued and seed can be sent to any breeder or geneticist who requests germ plasm for his particular purpose, one of the major objectives of making the collections will have been accomplished.

COLLECTING PROCEDURES

Collections in the Andean Region were made in cooperation with the maize workers of each country. With few exceptions collections were made directly from farmer's fields, but market places were also checked to be sure that no unusual types had escaped the field collectors. The collectors worked in the field during the harvest seasons and returned to the germ-plasm bank to help classify and catalogue the material in the off-seasons. A

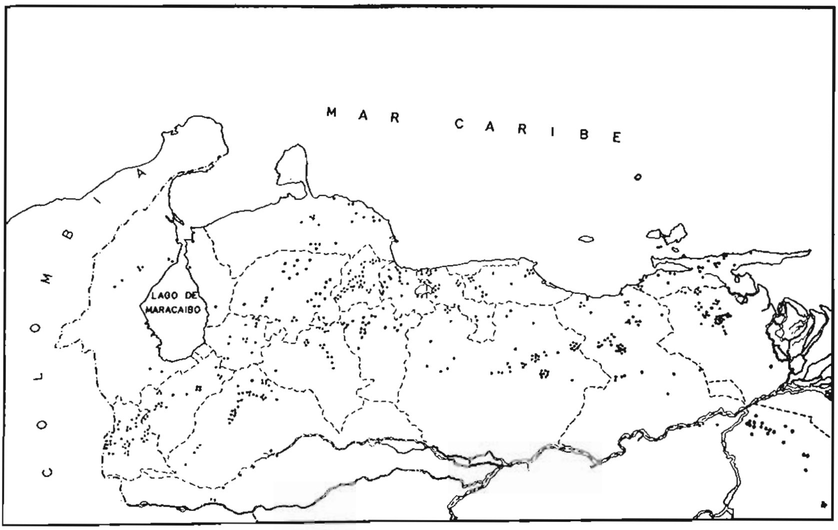

FIG. 2. Map of Venezuela showing the localities from which the maize collections were made.

minimum of 15 ears from each field was collected where possible, and an effort was made to include among this number a good representation of the variation in plant and ear type. A map showing the locations of the 685 Venezuelan collections is shown in Fig. 2.

Samples were air-shipped to the center at Medellín, Colombia, where they were dried, catalogued and photographed, and data on the ear and kernel characters were taken. A museum sample of three whole ears was kept and the remaining ears were shelled and the seed was mixed within each collection. Four-ounce samples of each collection were put into cold storage at Medellín and these are renewed periodically at experimental stations at various elevations by sib-pollination. As a precaution against fire, earthquake, or other disaster, duplicate samples were sent to the United States for safe keeping in the germ-plasm bank at Fort Collins, Colorado, by the Division of Foreign Plant Introduction of the United States Department of Agriculture. As the classification of the races was completed, seed of the several collections of each race was mixed. A large sample is kept under refrigeration at the germ-plasm bank and a duplicate sample was sent to Fort Collins for safe keeping. Only those collections judged to be relatively "pure" and representative of the race were included in such mixtures. Collections which were obviously mixtures were not included with the representative types. In addition to the "pure" race composites, others are being made of the collections where obvious introgression has occurred. For example, Costeño and Común overlap geographically, and it is sometimes difficult to determine where Común begins and Costeño ends (see Figs. 60 and 72). Therefore mixtures of the collections which are obviously intermediate between "good" races are being made and maintained to avoid the possible loss of valuable germ-plasm that might not be represented in the relatively pure races. This procedure reduces the number of collections which must be maintained to a manageable size.

METHODS OF CLASSIFICATION

Much of the maize of Venezuela consists of recent introductions and mixtures of these with older indigenous races. This has introduced some confusion into the present attempt to classify Venezuelan maize. It now seems only too obvious that the Venezuelan collections were made about 20 years too late to make an entirely satisfactory account of the classification and distribution of the indigenous races. Examination of the distribution maps of *Pollo, Pira, Chirimito,* and *Aragüito* reveals that these types are found at some distance from the population centers of Maracaibo and Caracas, whereas the improved types of *Tuxpeño* and *Puya Grande* radiate out from these centers. This indicates that the small-eared, low-yielding types probably originally occupying these areas were rapidly replaced by high-yielding types as they became available. In spite of these difficulties, however, it is still possible to find many distinctive interbreeding populations which remain identifiable as races.

A well-defined race of maize should consist, ideally, of several collections which have a significant number of distinctive associated characteristics in common and which possess a homogeneous geographical distribution. In practice, the races of maize in Venezuela were recognized tentatively by studying the original collections of ears from the fields of Venezuela. Similar collections were placed side by side in groups on large tables in a well-lighted room. In this way it was not difficult to recognize certain basic types of maize, especially when these were well-known races already described from Colombia (Roberts *et al.*, 1957), Brazil (Brieger *et al.*, 1958) or the Caribbean (Brown 1960). Mixtures between these relatively pure basic types were also easily recognized for the most part. There remained the new endemic races of Venezuela, not previously described from other countries and often themselves hybrids of well-known races. If these new types were relatively uniform and possessed many distinctive features in common, they presented few difficulties. But if they were widespread, variable, and had been influenced by introgression from other races, then their recognition was often at best uncertain.

The identifications based on examination of the original ear samples were then checked in experimental plots. All relatively pure collections of any provisional race were grown in adjoining plots. These plots were carefully compared for uniformity within racial groups, and obvious errors in identification were corrected. Visual comparisons of plant and ear characteristics were made, often with the help of a set of photographs of the original ear collections. These observations led to the preparation in the field of brief diagnostic descriptions of the plants of each race. Finally, data were obtained from 10 to 20 plants in each of about three of the most typical collections of each race. An average of about 500 numerical measurements was made per collection and thus about 1,500 measurements for most races. Seed from the same collections was often grown at different experiment stations to determine the effect of environmental factors associated with elevation on the growth of the plants. These physiological effects are extremely useful in distinguishing races of maize. Highland races do not develop normally and often will not set seed if grown near sea level, for example, and the growth of lowland types at high elevations is also abnormal.

The original, provisional classification based on the ears brought from the fields of Venezuela was then revised, taking into consideration the observations made in the experimental plots. Diagnostic descriptions of the ears belonging to typical collections of each race were then made and the data on them assembled. The final conclusions and descriptions reported here are thus based on field and laboratory studies checked and repeated over several seasons.

It would be idle to assert that the considerable time and effort invested in this classification have eliminated all traces of subjective judgment. Obviously, there can be no hard and fast distinction between races and racial mixtures or even between closely related races. Complete objectivity is probably impossible in any study of the variation within a naturally cross-pollinated species, but careful and detailed study of collections in field and laboratory at least gives the student of maize some confidence in the correctness of his judgments.

CHARACTERS USED IN CLASSIFICATION

The same four principal categories of characters which were used in classifying *Races of Maize in Colombia* (Roberts *et al.*, 1957), have been used in this study. These are: 1) vegetative characters of the plant; 2) characters of the tassel; 3) characters of the ear, both external and internal; and 4) physiological and genetic characters. Also the same general procedures were followed in obtaining the measurements and in making the observations on the different characters used in these four principal groups.

The data presented in Tables 2-6 (Appendix) were taken from a selected group of collections which were chosen as being the most typical of a particular race. The number of collections that were selected as "type specimens" varied for any given race because in some instances the number of "pure" collections was very small and in others the number was so large that it was pointless to take additional data. The number and identity of the collections used as being the most representative of each race is given in the Appendix, Table 7.

Races of Maize in Colombia (Roberts *et al.*, 1957) gives a complete description of the characters employed in the classification and the techniques used to study them. For the convenience of the reader, a summary of the characters used in the present classification and the methods by which they were studied is given below.

VEGETATIVE CHARACTERS OF THE PLANT

Range of Adaptation to Altitude

The major factor influencing the distribution of Venezuelan races of maize is altitude, which is, of course, directly related to heat units. In Colombia, for example, it is difficult to get good seed from *Sabanero* and other highland races at an elevation of 4,500 feet. There is a difference between races in their ability to withstand changes in altitude. However, this is more than likely related to the amount of introgression of other types than it is to the "pure" race, although the adaptation of some races has a greater range than others. For example, the Caribbean Yellow Flint complex is an excellent source of germ plasm for maize breeding found throughout the Caribbean up to elevations of 5,000 feet, while the *Pollo* race in Colombia is found in a relatively restricted area and elevation in Cundinamarca and Boyacá.

Altitudes for most of the collections were accurately measured with an aneroid altimeter but, where this was not possible for a small percentage of the collections, the altitudes were taken from the best maps available.

Height of Plant

Plant height was obtained from an average plant of a typical collection grown at or near the elevation of its original habitat. The measurement was made from ground level to the base of the tassel.

Height to Ear

Ear height, for the uppermost ears, was not recorded directly in the field but was calculated from the internode measurements of all measured plants of typical collections.

Stem Diameter: Maximum and Minimum

The means by races for these characters are averages of all plants measured at the midpoint of the first internode above ground level on the main stalk. Comparison of maximum and minimum diameters of the main stalk at the mid-point of the first internode gives an indication of its cross-sectional shape. Some races have slightly elliptical stems; other have stems which are almost round; the majority have stems which fit between these two extremes in shape.

Length of Leaf

The mean for each typical collection is based on the measurement of a leaf from all normal plants in a plot. The measurements were made from the ligule to the tip of the leaf arising immediately above the ear-bearing node. The means of the representative collections were averaged to obtain the racial means for this character.

Width of Leaf

The same procedure was followed as for length of leaf, the measurement being made at the mid-point in the length of each leaf.

Venation Index

The procedure described in the study of the races of Mexico (Wellhausen *et al.*, 1952) was used to derive this index. It consists of the quotient of the average number of veins counted at the mid-point in the length of the leaf arising immediately below the upper ear-bearing node and the average width at the same point. The counts and measurements were made on all plants scored in each collection.

Number of Tillers

Actual counts were made on all plants scored. The means of the typical collections were averaged to derive the racial means. Tillers were also given a height score of tall, medium, or short. Those scored tall were equal or almost equal to the main culm.

Medium tillers were approximately one-half the height of the main culm and those scored short were less than one-half the height of the main culm. Class percentages for height were calculated from the total number of tillers.

Plant Diagrams

The accompanying diagrammatic representations of plants of the Venezuelan races were made from data taken on actual measurements of plants of each race. Internode lengths and ear positicns were taken from a plant with the model number of internodes of its race. Tassel diagrams show in correct scale the length of the longest and shortest tassel branches, the mean number of branches, including secondaries and tertiaries, and the mean lengths of peduncle, central spike, and branching space. In these diagrams no attempt was made to show the angles at which the tassel branches emerge from the rachis, their relative stiffness, and similar elements which contribute to the total visual impression given by a living tassel.

In many respects internode-pattern diagrams, which these plant diagrams replace, are not entirely satisfactory. The procedure used in earlier monographs in this series was to determine the modal number of internodes of each race and to average the measurements of internode lengths of those plants possessing the modal number. In most cases, however, it was impossible to determine if corresponding (homologous) internodes were being averaged. Consequently, the net impression often was one of more precision than the procedure really warranted. A composite picture of the internode diagrams of several individual plants of each race would be extremely useful, but we have not been able to devise a simple technique for reducing our voluminous internode data to such a diagram.

CHARACTERS OF THE TASSEL

Length of Peduncle

The distance was measured in centimeters from the upper node of the stalk to the lowermost branch of the tassel.

Length of Branching Space of Tassel

The distance was measured in centimeters along the central axis of the tassel between the basal and uppermost primary branches.

Length of Central Spike

This length was measured in centimeters between the uppermost primary branch and the apex of the tassel.

Also measured were the lengths of the uppermost primary branch and the best-developed primary branch; the number of secondary and tertiary branches on the best-developed primary; the number of primary branches with secondaries; the number of primary branches with tertiaries; and the total number of primary branches. From these measurements several useful indices, such as branching-space percentage, can be derived.

EXTERNAL CHARACTERS OF THE EAR

Ear Length

The measurements were made on normally developed ears in each collection.

Ear Diameter

The diameters of the same ears used to determine ear length were measured with calipers at the base, mid-point, and tip of the ear.

Row Number

Actual counts were made of the number of rows of grain on the same ears used for length and diameter determinations.

Number of Husks

The husks (modified leaf sheaths) surrounding the ear were counted on the principal ear of all plants scored. The data are expressed as an average per plant. The number of condensed husk nodes of the shank was also determined by counting the number of apparent nodes and comparing it with the number of husks produced.

Kernel Width

The width of 10 kernels taken from near the middle of the ear and laid side by side was measured in millimeters.

Kernel Length

The same 10 kernels were measured in millimeters when laid end to end.

Kernel Thickness

The thickness of 10 consecutive kernels in a row near the midpoint of an ear was measured in millimeters with metal calipers. The measurements were made while the kernels were on the ear.

Kernel Denting

This is a visual estimate on an individual ear basis recorded on an arbitrary scale; from 0 (maximum) to 5 (none). Observations were made on the same ears as for the above characters.

Kernel Hardness

Visual estimates were made on individual ears and these were recorded on an arbitrary scale from 1 (hard) to 5 (soft). This is presented as an average for the same ears used for the other characters.

INTERNAL CHARACTERS OF THE EAR

Cob Diameter

This was measured with calipers from the center of the upper surface of the glume on one side of the cob to the corresponding point on the upper surface of a glume directly opposite.

Rachis Diameter

This was measured with calipers on the lower half of the broken ear. The measurement was made from the base of an upper glume on one side of the cob to the base of an upper glume directly opposite. Since the base of the glume is usually somewhat below the rim of the cupule, this measurement does not represent the maximum diameter of the rachis but rather its diameter to the points at which the upper glume arises.

Cob/Rachis Index

This is computed by dividing the diameter of the cob by the diameter of the rachis.

Glume/Kernel Index

This index gives a measure of the length of the glume in relation to the length of the kernel. It is computed by subtracting the diameter of the rachis from the diameter of the cob and dividing the figure obtained by twice the average length of the kernel.

Cupule Hairs

The cupule, a term designating the depression in the rachis from which the spikelets arise, is almost invariably hairy. The hairs vary both in number and length from a few short prickles to many long, sometimes appressed hairs. They also vary greatly from race to race in their distribution within and about the cupule. The variation is so extensive that the characteristic alone is of little value. It may, however, be useful when considered with other characteristics and employed as part of the total description. Hairiness is scored by numbers from 0 (none) to 2 (profuse).

Lower Glume: Hairiness

The hairs of the lower glume vary in number, length, and position. Hairs are found almost universally on the upper margins of the glume. These vary from a few short hairs to many long, soft hairs. The surface of the glume proper may be completely glabrous. More commonly, a few hairs are found at the base or toward the lateral margins of the glumes. In general, the hairiness of the lower glume is not in itself a satisfactory diagnostic character, since there is often considerable variation within a race. Considered with other characteristics, however, it has some usefulness. Hairiness of the glumes is scored by numbers, from 0 (none) to 2 (profuse).

Lower Glume: Shape of the Glume Margin

The upper margin of the glume varies in shape from race to race. The margin is rarely truncate and is usually more or less indented. The indentation may be luniform (crescent-shaped), more or less broadly angulate (wedge-shaped), sinuate (undulate or wavy), or cordate (heart-shaped). The shape of the margins is fairly uniform among different ears of the same race.

Upper Glume: Hairiness

Hairs on the upper glume, like those on the lower, vary in number, length, and position and are scored in the same way.

PHYSIOLOGICAL AND GENETIC CHARACTERS

Maturity

The number of days from planting to silking was used as a measure of maturity. The date of silking for each collection was recorded when one-half of the plants in a plot containing 50 to 60 plants had put forth silks.

Corn Rust

Three species of corn rust, *Puccinia sorghi, P. polysori,* and *Angiospora zeae,* have been identified on maize grown in Colombia. Since *P. sorghi* is of major importance and the other two species are relatively unimportant, only one rust note was taken with respect to the degree of resistance or susceptibility on the scale 1 to 5; 1 being highly resistant and 5 highly susceptible. The various races of maize exhibited considerable difference in reaction to *P. sorghi.*

Helminthosporium

This disease, like rust, is very common and damaging in parts of Colombia. To date the importance of the species of *Helminthosporium* prevalent in Colombia has not been determined with any degree of certainty, although it is fairly apparent that *H. turcicum* largely predominates with *H. carbonum* present but not so important. All of the collections have been scored for resistance or susceptibility to this disease although no distinction is made in the report between the two species of leaf blight. The scale used for recording the visual estimates was from 1 (resistant) to 5 (susceptible).

Pilosity

Pubescence in Table 6 is arbitrarily scored from 1 to 5 for both frequency and intensity, the higher number indicating the stronger pubescence. Texture of pubescence was scored as hard, medium, and soft.

Plant Color

Many high-altitude races of Central and South America have strongly colored leaf sheaths. This color is sometimes due to the B factor on chromosome 2, sometimes to one of the R alleles on chromosome 10, and sometimes results from both. The empirical scores in Table 6, ranging from 1 to 5, do not distinguish between these two genes for color. Color, like pubescence, reaches its maximum intensity in the high-altitude corns. A visual estimate was made in a plot of from 50 to 60 plants of each collection for both frequency and intensity to arrive at an arbitrary score. Purple and brown plant color were scored separately using a scale of 1 to 5, with 5 representing the most intensive plant color.

Lemma Color

The color of red-cobbed corn is in the lemma, but there are other colors in the lemma as well. No attempt was made to distinguish between colors due to the different genes involved, and only the presence or absence of color was noted on 10 to 15 ears of each original collection. This is expressed (Table 6) as percentage of ears with lemma color among the ears which were scored for this character.

Glume Color

Lacking anthocyanin, the glumes are white, buff, or brownish. Anthocyanin coloration may be red, cherry, or purple. The frequency of glume color is recorded as a percentage of the ears of the original collections which were studied.

Aleurone Color

Expressed in percentage of the ears of the original collections that had aleurone color, irrespective of its nature.

Pericarp Color

Scored on 10 ears of the original collections and expressed as a percentage.

DESCRIPTION OF RACES

The following is a description of 19 races of maize found growing in Venezuela. Several of these races have important variations which are discussed in this report. The origins of the Venezuelan races described herein are not treated in detail. We agree with Brown (1960) that "this general subject cannot be dealt with with any finality until the breeding behavior of West Indian maize and its nearest South American counterparts is better known than it is at present." A study of the following descriptions of Venezuelan maize will reveal numerous similarities to Colombian and West Indian maize, although several of these races are described for the first time.

CHIRIMITO

Plants. Medium height; no tillers; nodes somewhat exserted; sun-red and purple colors common; some stalks zig-zag; mean altitude of type collections 180 meters; range: 100 to 300 meters.

Tassels. Most tassels exserted; central spike prominent; tassel very dense with many long, stiff branches.

Ears, external characters. Very short, small, cigar-shaped to gently tapering; rows 14 to 18 mostly spiral and irregular; kernels small, round, deep with pop-type white endosperm, occasional blue aleurone; staminate tips in many ears; glumes long, often colored.

Ears, internal characters. Average ear diameter 29.5 mm; average cob diameter 15.9 mm; average rachis diameter 11.6 mm; cob/rachis index 1.37.

Discussion. Chirimito, Canilla Venezolano, and *Guaribero* are set apart from the other races of Venezuelan maize by the tessellated arrangement of their small, round, hard grains. In addition *Chirimito* and *Canilla Venezolano* possess thin, flexible cobs from which the grains shatter readily. Two other races previously described in this series—*Clavo* of Colombia (Roberts *et al.,* 1957) and *Clavillo* of Central America (Wellhausen *et al.,* 1957)—share these characteristics, although ear row numbers are generally higher in *Chirimito* and *Canilla Venezolano.* Certain ears of *Chirimito* also resemble the round-seeded forms of Guaraní popcorn (Brieger *et al.,* 1958; Fig. 70), and like these tend to produce staminate spikelets at the tip of the ear.

Chirimito is somewhat variable, and forms with straight rows and wide, somewhat flattened grains intergrade into the race *Aragüito.* These strongly tapering ears are reminiscent of the white seeded forms of *Nal-Tel* found in Guatemala (cf. Wellhausen *et al.,* 1957, Fig. 5). *Pira* which occurs in Colombia and western Venezuela, also seems to be related to *Chirimito.* Unlike *Chirimito,* however, *Pira* has thin, cylindrical ears, usually with no more than ten or twelve straight rows and grains which are much wider than thick.

The present distribution of *Chirimito* in Venezuela is very widely scattered and provides little indication of a possible area of origin. *Chirimito* possesses a combination of characters often considered primitive—small ears, small hard grains, and a tendency to produce staminate spikelets at the tips of the very thin ear rachis. Since no race in Venezuela, Colombia, or the West Indies yet described seems a likely ancestor, *Chirimito* is probably best regarded as a relict ancient race with more southern affinities. Through *Canilla Venezolano* it has influenced *Chandelle,* both in Venezuela and the West Indies. Its affinities with *Clavo* and *Clavillo,* although more remote, are also readily apparent. By hybridization with a thick-cobbed maize it could have given rise to *Guaribero.*

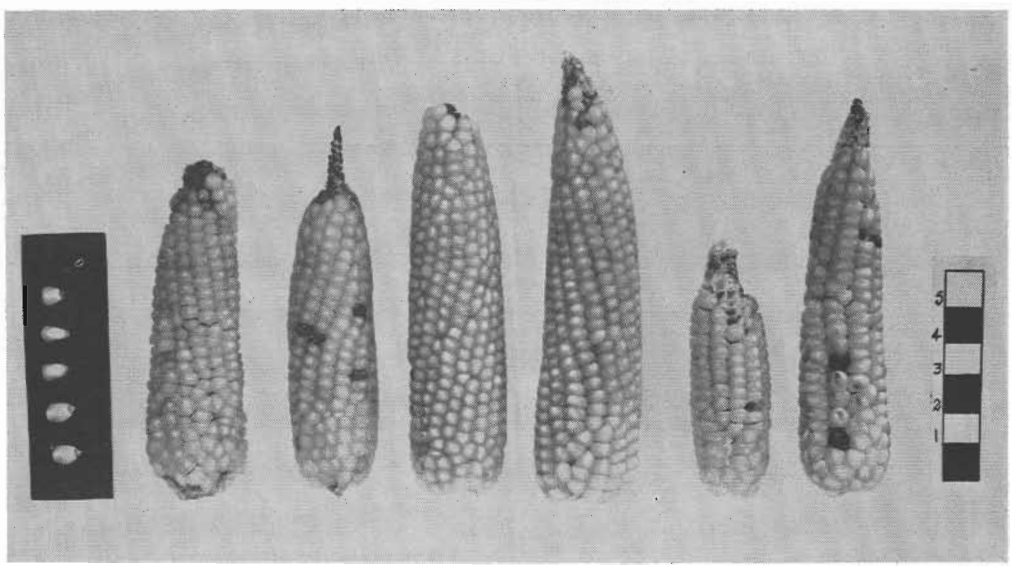

FIG. 3. Representative ears of Chirimito. This race occurs in two forms; one with high number of irregular rows and the other with somewhat round grained straight rows.

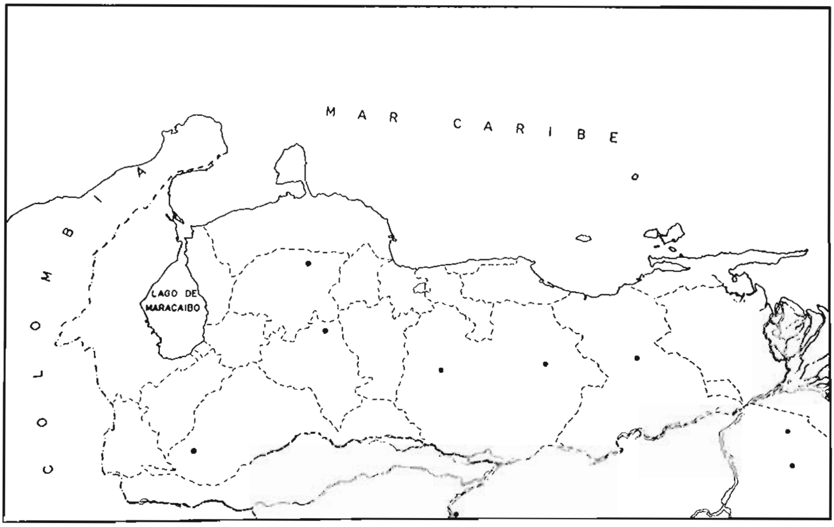

FIG. 4. The distribution of Chirimito.

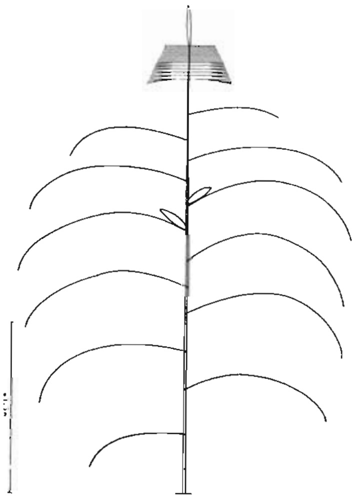

FIG. 5. Plant Diagram of Chirimito.

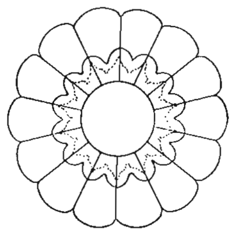

FIG. 6. Ear cross-section diagram of Chirimito.

ARAGÜITO

Plants. Short, slender, some zig-zag stalks; with well-exserted nodes; some plant color; leaves tend to be stiff and perpendicular to stalk; little pubescence; mean altitude of type collections 170 meters; range: 10 to 200 meters.

Tassels. Most tassels well exserted; prominent central spike; mostly dense; sterile zone of branches short; little condensation.

Ears, external characters. Short, stubby, strongly conical; rows 12 to 14, mostly straight or slightly spiraling; grains white round pearl pop type; barren tips common; some colored aleurone; similar to *Nal-Tel* race of Mexico and Guatemala.

Ears, internal characters. Average ear diameter 31.2 mm; average cob diameter 15.3 mm; average rachis diameter 11.1 mm; cob/rachis index 1.38.

Discussion. This maize is so similar to the white *Nal-Tel* of Central America (Wellhausen *et al.*, 1957) that the possibility of a recent introduction to Venezuela must be considered. *Aragüito,* however, is concentrated in the old Carib region of eastern Venezuela, rather distant from important modern seaports. It seems to have hybridized with *Chirimito* to produce the common race *Guaribero,* the very abundance of which, in fact, strongly suggests that *Aragüito* must be a relatively old type of maize in Venezuela. It also has crossed with *Cariaco* to produce a floury maize with rosy, often dotted aleurone (Fig. 8).

Aragüito is also known as "Arapito" and "Cuarentón" in eastern Venezuela. The latter name suggests the earliness of this maize which, according to some farmers, is ready for harvest forty days after planting. It is apparently the same race mentioned by Gumilla (1791), who was told that it produced six crops a year.

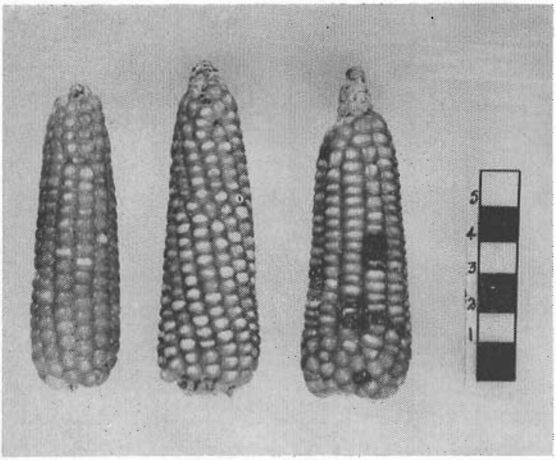

Fig. 7. Representative ears of Aragüito. Note the similarity to Nal-Tel Blanco of Guatemala.

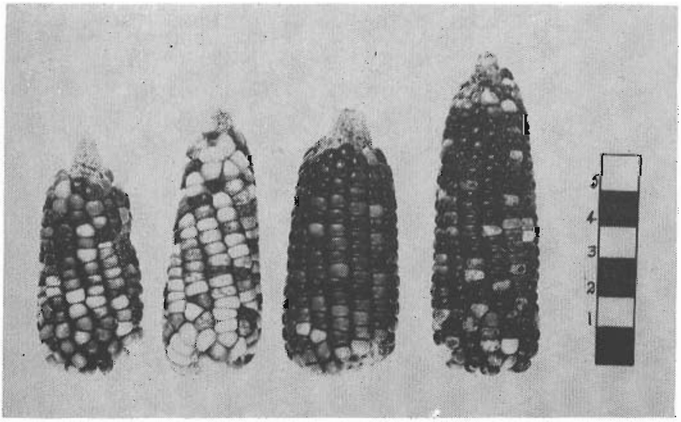

Fig. 8. Aragüito sometimes appears in a floury endosperm form with rose colored and occasionally dotted aleurone.

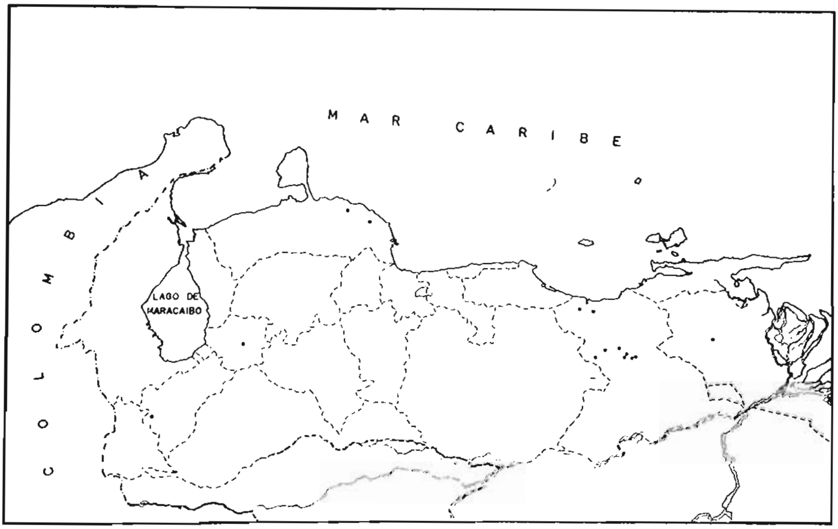

FIG. 9. The distribution of Aragüito.

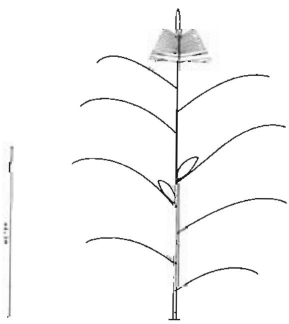

FIG. 10. Plant Diagram of Aragüito.

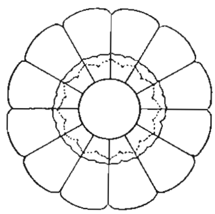

FIG. 11. Ear cross-section diagram of Aragüito.

POLLO

Plants. One to two meters tall; stalk somewhat spindly often zig-zag; leaves somewhat stiff but with a gentle arch, relatively wide; ears placed low on stalk; nodes strongly exserted; mean elevation of typical collections 1,380 meters; range: 1,300 to 2,400 meters.

Tassels. Strongly exserted; long branches at base; branches stiff to somewhat curved; some plants with short stiff, upright branches; prominent central spikes; prominent sterile zone on primary branches.

Ears, external characters. Short, tapering, with 8 to 10 mostly straight rows but some with irregular bases; kernels wide, rounded; endosperm flinty, white and yellow, red pericarp and blue aleurone common.

Ears, internal characters. Average ear diameter 36.7 mm; average cob diameter 18.9 mm; average rachis diameter 13.0 mm; cob/rachis index 1.45.

Discussion. The distribution of *Pollo* in Venezuela is restricted to the Andean highlands, and it is most abundant in Táchira, adjacent to Colombia. The Venezuelan collections are more mixed than those from Boyacá, Colombia. Apparently considerable introgression from other races has occurred.

Pollo, like *Pira,* is curiously isolated from other races of Andean maize. It is true that *Pollo* intergrades with *Sabanero* in Colombia, but this most probably indicates mixing of two formerly distinct races. *Sabanero,* in fact, seems much more closely related to the small-eared race *Patillo,* of Bolivia and Ecuador (Ramírez *et al.,* 1960; Timothy *et al.,* 1963). On the other hand, the resemblance of *Pollo* to the Guatemalan races *Quicheño Precoz* and *Serrano* (and to a lesser extent to *Nal Tel Tierra Alta*), described by Wellhausen *et al.* (1957) is striking. At present it is quite impossible to suggest if *Pollo* is a very ancient relict or merely a vestige of a more recent cultural interchange between the highland Maya of Central America and the Chibchan-Timotean tribes of the northeastern Andes.

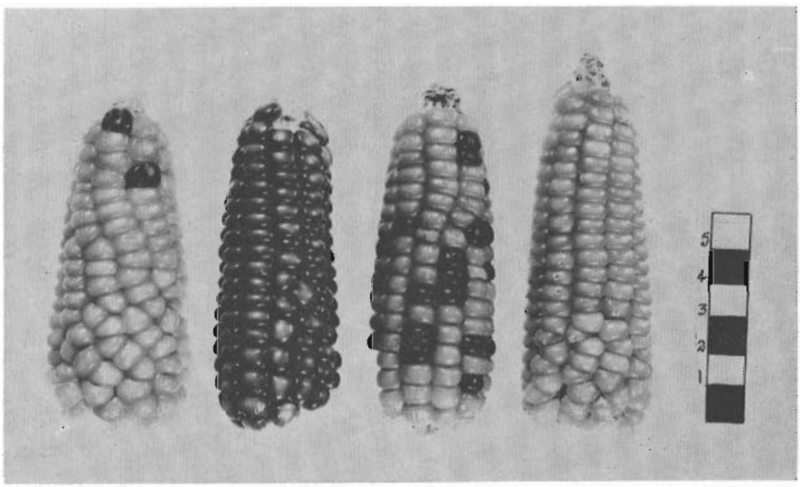

FIG. 12. Representative ears of Pollo.

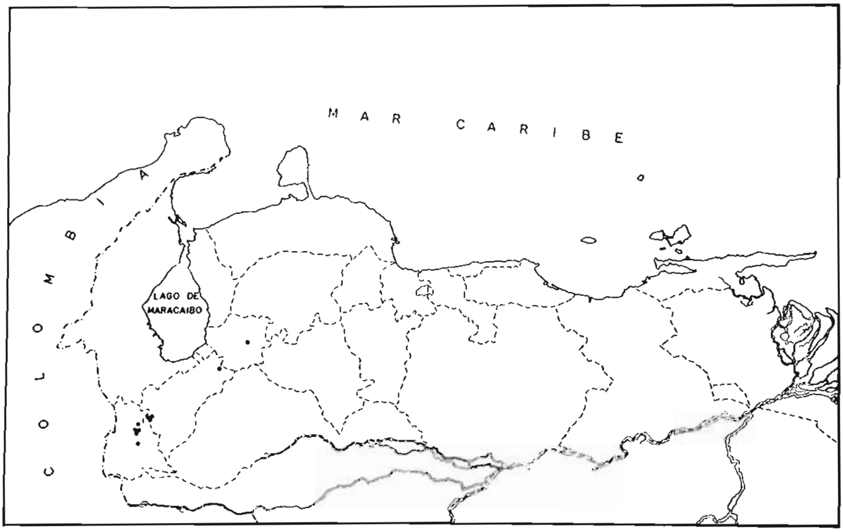

FIG. 13. The distribution of Pollo.

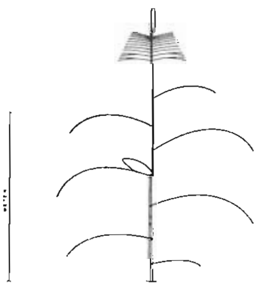

FIG. 14. Plant Diagram of Pollo.

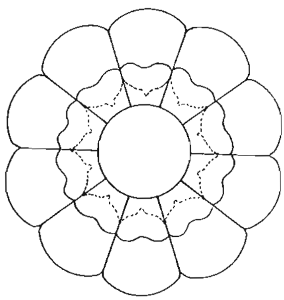

FIG. 15. Ear cross-section diagram of Pollo.

CANILLA VENEZOLANO

Plants. Two to three meters tall; leaves arched, medium long, medium wide; nodes well exserted; sturdy stalk; ears relatively high; medium color; highly pubescent; relatively resistant to rust and Helminthosporium; mean elevation of typical collections 260 meters; range: 20 to 450 meters.

Tassels. Well exserted, somewhat open; tassel branches long, stiff, with prominent sterile zones.

Ears, external characters. Long, slender, tapering with 14 to 18 tessellated rows; grains deep, round, hard, white, shattering readily from the cob; tips often with staminate spikelets; cob white or colored, flexible, with soft glumes.

Ears, internal characters. Average ear diameter 33.7 mm; average cob diameter 18.2 mm; average rachis diameter 12.2 mm; cob/rachis index 1.49.

Discussion. The distribution of *Canilla Venezolano* is strikingly similar to that of *Guaribero.* Both are strongly concentrated in the area east of Caracas and north of the Orinoco which was formerly dominated by Carib-speaking tribes, with scattered occurrences farther west. *Canilla Venezolano* is similar to *Chirimito* in many characters, the most obvious of which are ear shape, type of grain, high ear row number, and the ease with which the grains shatter from the cob. *Canilla Venezolano* is also similar to the Colombian race *Clavo,* from which it differs chiefly in its adaptation to lower elevations and its somewhat higher ear row number. *Clavo,* in fact, may have originated from a cross between *Canilla Venezolano* and an Andean maize with a thin rachis and a low row number (for example, the Colombian-Ecuadorian race *Cabuya).* The influence of *Canilla Venezolano* is readily apparent in *Maiz Chandelle,* the other parent of which was a straight-rowed yellow dent, possibly the form of *Puya* common around Lake Maracaibo.

Canilla is the common name of this type of maize in eastern Venezuela. It is not to be confused with *Maiz Canilla* of Cuba (Hatheway, 1957), which is the name commonly given to *Maiz Chandelle* on that island.

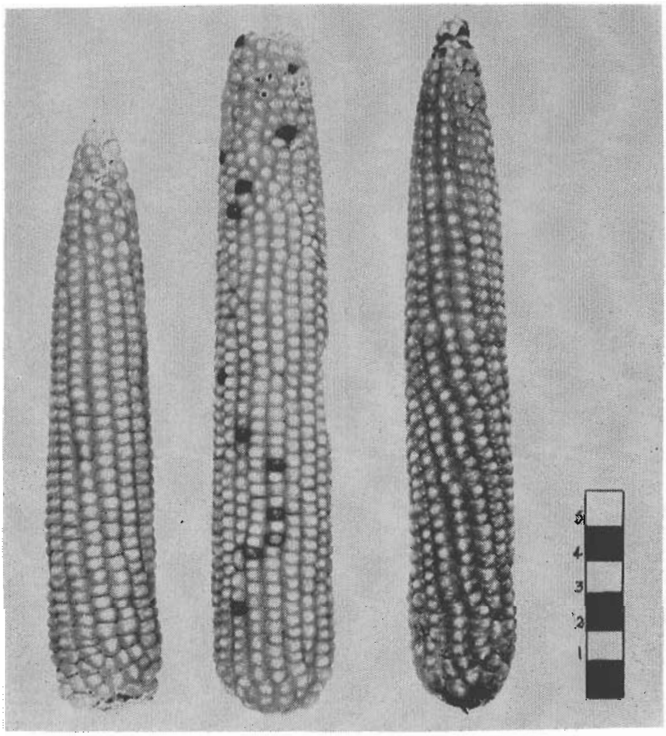

FIG. 16. Representative ears of Canilla Venezolano.

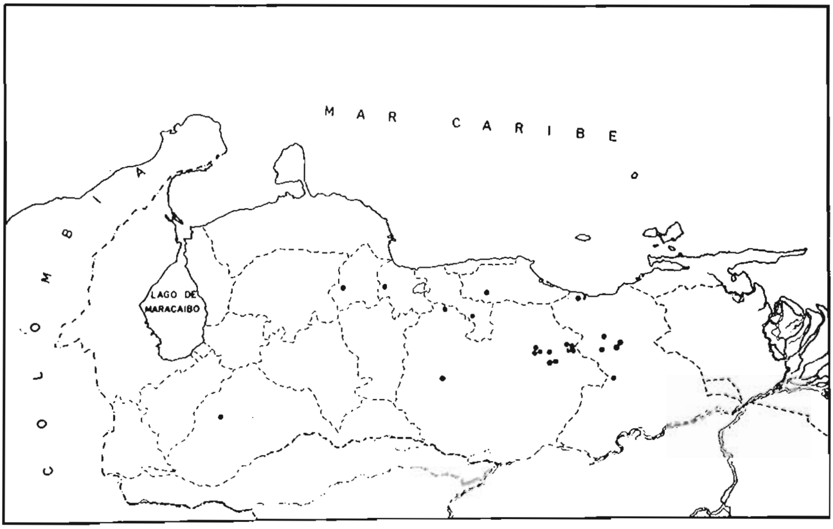

FIG. 17. The distribution of Canilla Venezolano.

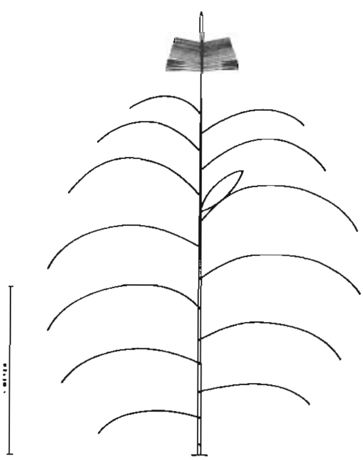

FIG. 18. Plant Diagram of Canilla Venezolano.

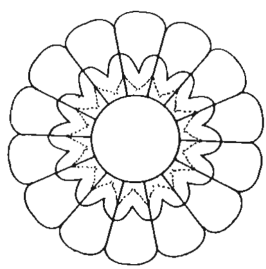

FIG. 19. Ear cross-section diagram of Canilla Venezolano.

PIRA

Plants. Short to medium height; stalks thin; a few short tillers; leaves long and narrow; little pubescence. Resistant to rust and Helminthosporium; average elevation of typical collections 780 meters; range 180 to 1,000 meters.

Tassels. Medium number of short, stiff branches; prominent central spike.

Ears, external characters. Short; very slender, somewhat flexible, with 10 to 12 straight rows; grains pearly white pop type; ear slightly tapered.

Ears, internal characters. Average ear diameter 25.6 mm; average cob diameter 13.8 mm; average rachis diameter 8.2 mm; cob/rachis index 1.68; some glume color.

Discussion. Only a few collections of *Pira* were made in Venezuela, and of these typical forms were restricted to the state of Táchira, adjacent to Colombia. The remaining collections were strongly influenced by introgression from other races. It is interesting to note that *Pira* was not collected in Ecuador (Timothy *et al.*, 1963), nor is it mentioned as occurring in Panama or Central America by Wellhausen *et al.* (1957). Consequently, the distribution of *Pira* is clearly centered in the Magdalena valley of Colombia at low to intermediate elevations. It seems curiously isolated geographically and genetically, for it has no obvious close relatives or races to which it has given rise by hybridization or selection.

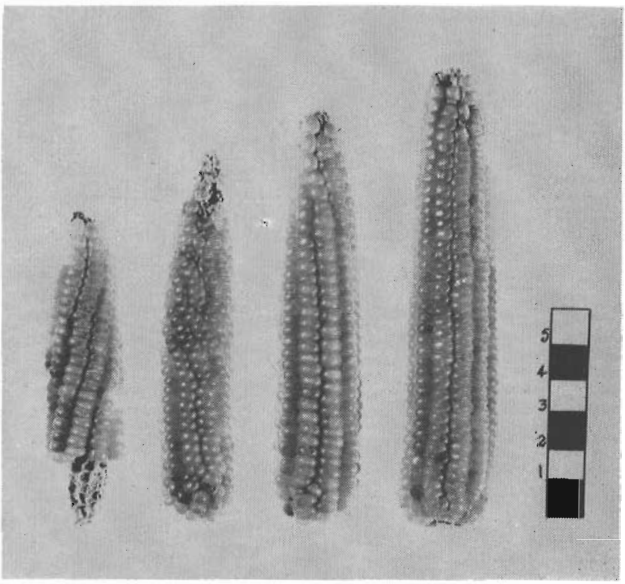

FIG. 20. Representative ears of Pira.

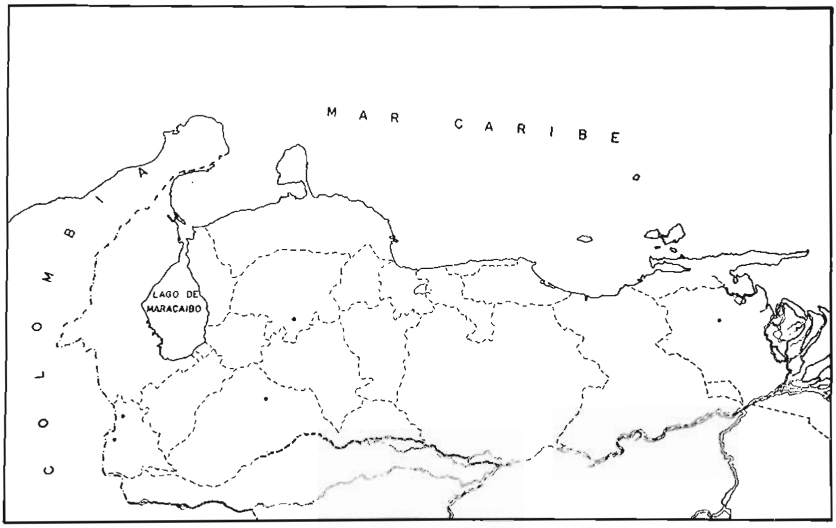

FIG. 21. The distribution of Pira.

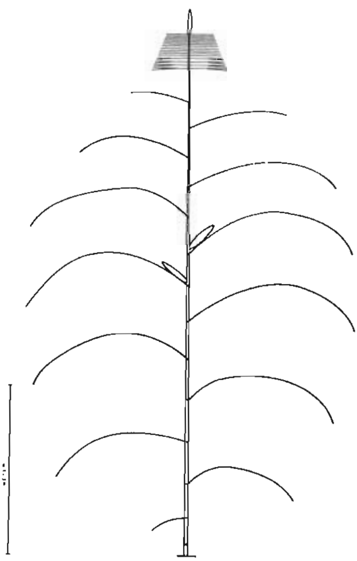

FIG. 22. Plant Diagram of Pira.

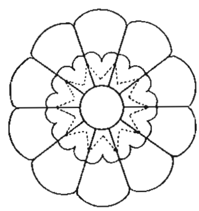

FIG. 23. Ear cross-section diagram of Pira.

CARIACO

Plants. Average height of plant 2.4 meters; few tillers; stiff wide leaves; nodes slightly exserted; some plant color; strongly pubescent; moderately resistant to rust and Helminthosporium; mean elevation of typical collections 200 meters; range: 100 to 1,500 meters.

Tassels. Dense to somewhat open, with short, stiff, erect branches; secondary branches common; tassels well exserted.

Ears, external characters. Short cylindrical to conical with 14 to 18 straight rows; grains wide, flat, soft, white or with lemon yellow aleurone; occasional red and varigated pericarp; adherent shanks; barren tips common; grain easily shelled; strong husk compression.

Ears, internal characters. Average ear diameter 42.9 mm; average cob diameter 24.4 mm; average rachis diameter 17.2 mm; cob/rachis index 1.42.

Discussion. Cariaco is a thick-cobbed, stubby lowland flour corn with high ear row number, widely distributed in Venezuela. The most common form, which is somewhat conical and has many rows of soft white grains, is concentrated in the departments east of Caracas. A cylindrical form of *Cariaco* with orange-yellow aleurone, lower row number, and exposed ear tips occurs on the eastern flanks of the Andes south of Lake Maracaibo. This form is very similar to Colombian *Cariaco*, described by Roberts *et al.* (1957), but lacks the conspicuous pericarp colors of the latter. There seems to be no reason to question Brieger's assertion that *Cariaco* belongs to the complex of soft flour races of the South American lowland Indians (cf. Brieger *et al.*, 1958, Figs. 81 and 83).

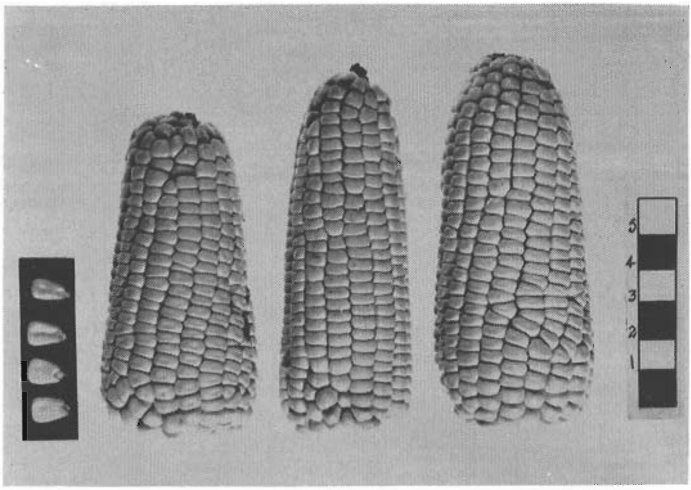

Fig. 24. Representative ears of Cariaco. This race commonly occurs with white and yellow endosperm. The white type shown here is somewhat conical with a high row number and is common in eastern Venezuela.

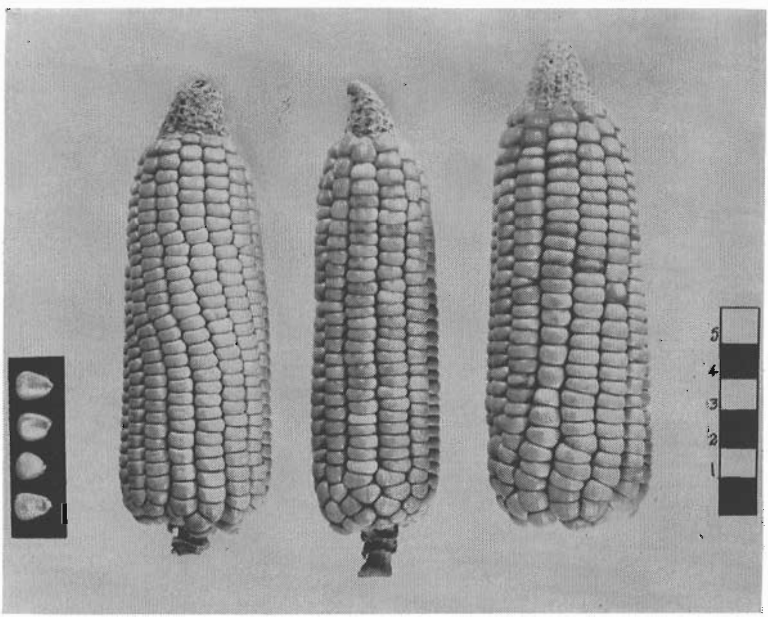

Fig. 25. Representative ears of Cariaco. The lemon yellow aleurone type has a more cylindrical ear and somewhat wider grains than the white form.

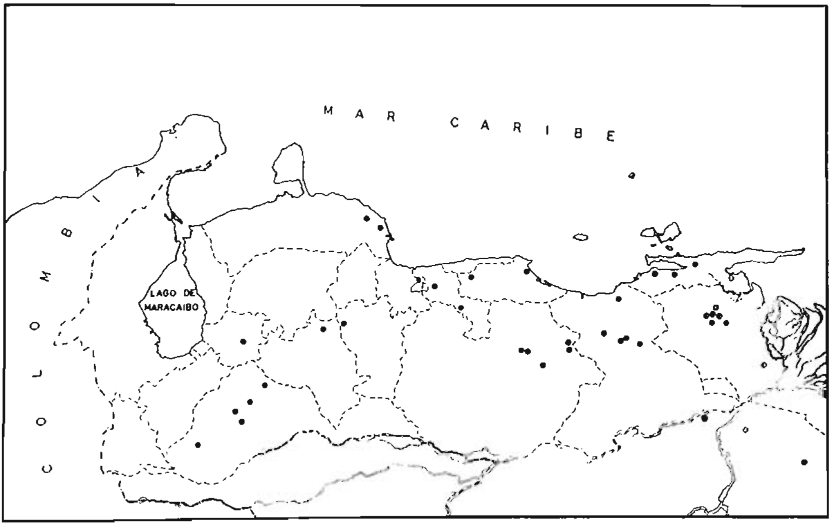

FIG. 26. The distribution of Cariaco.

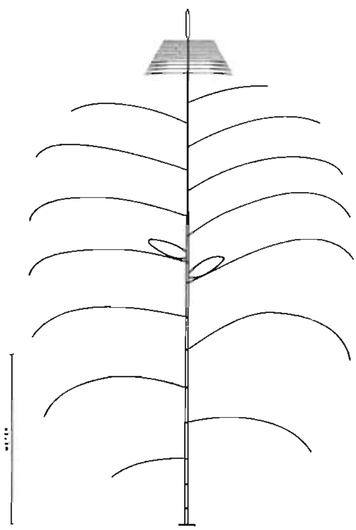

FIG. 27. Plant Diagram of Cariaco.

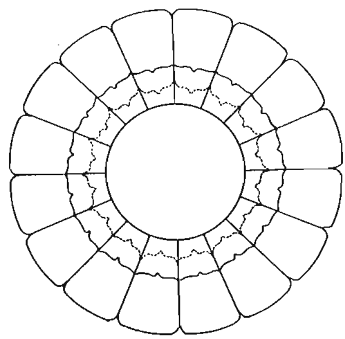

FIG. 28. Ear cross-section diagram of Cariaco.

GUARIBERO

Plants. Medium height; variable; zig-zag stalk common; sun-red and purple and green plants; little pubescence; resistant to rust and Helminthosporium; mean elevation of typical collections 115 meters; range 10 to 400 meters.

Tassels. Well exserted; central spike prominent but small; upper branches dense, stiff; lower branches droop.

Ears, external characters. Short, thick, slightly tapered; rows 16 to 20; kernels white, small, round, deep, semi-pop, frequently with soft cap; barren tips.

Ears, internal characters. Average diameter of ear 36.4 mm; average cob diameter 20.3 mm; average rachis diameter 14.6 mm; cob/rachis index 1.39.

Discussion. The distribution of *Guaribero,* like that of *Canilla Venezolano* and *Aragüito,* is concentrated in the former Carib area southeast of Caracas. With its stubby conical ears, high row number, and densely arranged flinty grains, it possesses a distinctive combination of characters suggestive of an indigenous race of some antiquity. The origin of *Guaribero* is probably to be sought in a cross between *Aragüito* and *Chirimito* or *Canilla Venezolano. Guaribero* also intergrades with *Costeño* and may in fact be one of the parents of that widespread race.

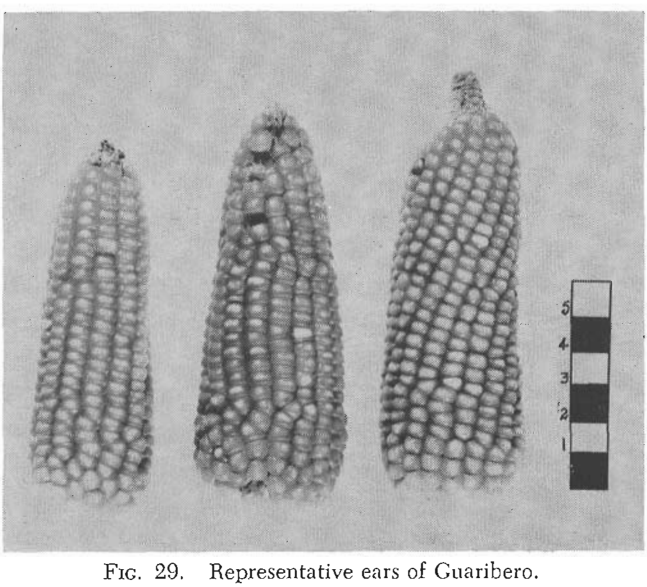

FIG. 29. Representative ears of Guaribero.

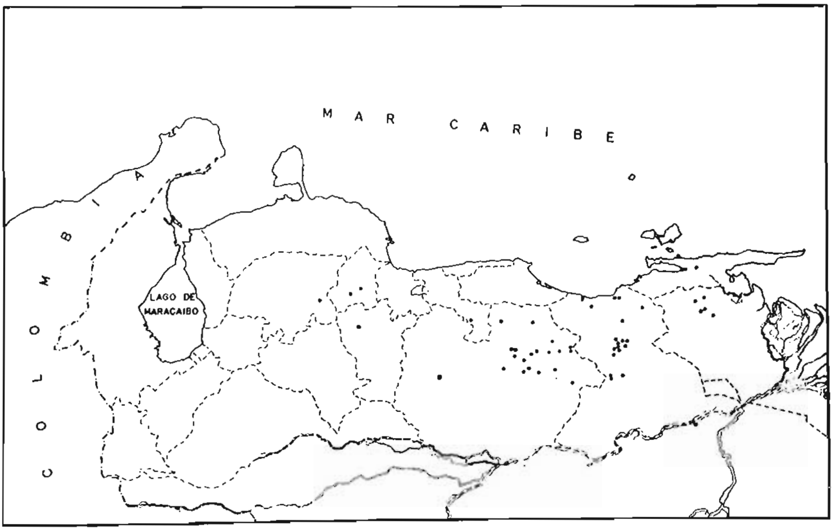

FIG. 30. The distribution of Guaribero.

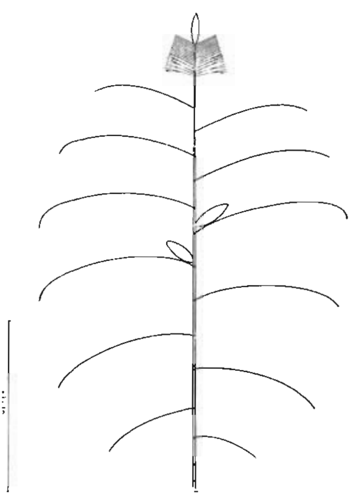

FIG. 31. Plant Diagram of Guaribero.

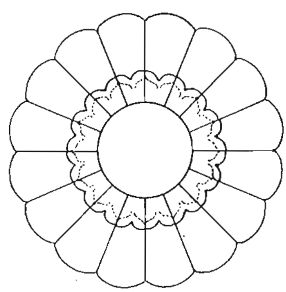

FIG. 32. Ear cross-section diagram of Guaribero.

SABANERO

Plants. Relatively tall, somewhat spindly; nodes well exserted; leaves long and fairly wide; ear carried high on plant; much plant color; highly pubescent; susceptible to rust and Helminthosporium; mean altitude of type collections 2,430 meters; range 840 to 2,970 meters.

Tassel. Well exserted, open with many secondary branches; prominent central spike; branches mostly stiff, short, little condensation.

Ears, external characters. Relatively short, conical, or tapering with straight or somewhat spiraling rows, large round white floury or flinty grains; pericarp and brown and blue aleurone colors common.

Ears, internal characters. Average ear diameter 44.3 mm; average cob diameter 25.5 mm; average rachis diameter 16.7 mm; cob/rachis index 1.53.

Discussion. The Andean race *Sabanero* was first described in Colombia, where it is the dominant type in the eastern Cordillera (Roberts *et al.*, 1957). Typical *Sabanero* also occurs in the Colombian department of Nariño and in adjacent northern Ecuador (Timothy *et al.*, 1963). The related race *Patillo,* with much smaller ears, also occurs in Ecuador and Bolivia (Ramírez *et al.*, 1960), and *Sabanero* itself has been reported in Perú (Grobman *et al.*, 1961). It is not surprising, therefore, to find *Sabanero* in the Venezuelan Andes, but these collections are not abundant and are somewhat mixed. In Táchira at intermediate elevations a floury form is dominant, but in Mérida at higher elevations this is replaced by a larger-eared type with flinty kernels in which dark aleurone colors are common.

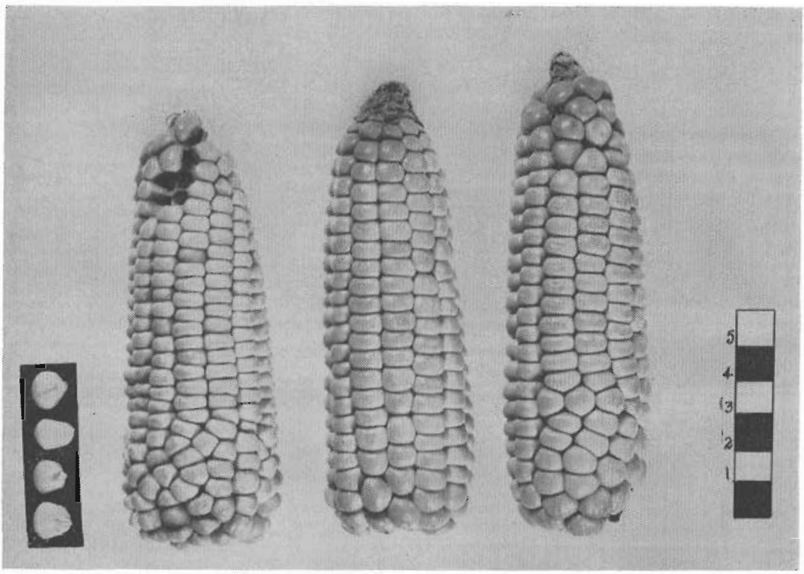

FIG. 33. Representative ears of Sabanero. The floury types were found in Táchira and the flinty types were concentrated in the adjacent state of Mérida at higher elevations.

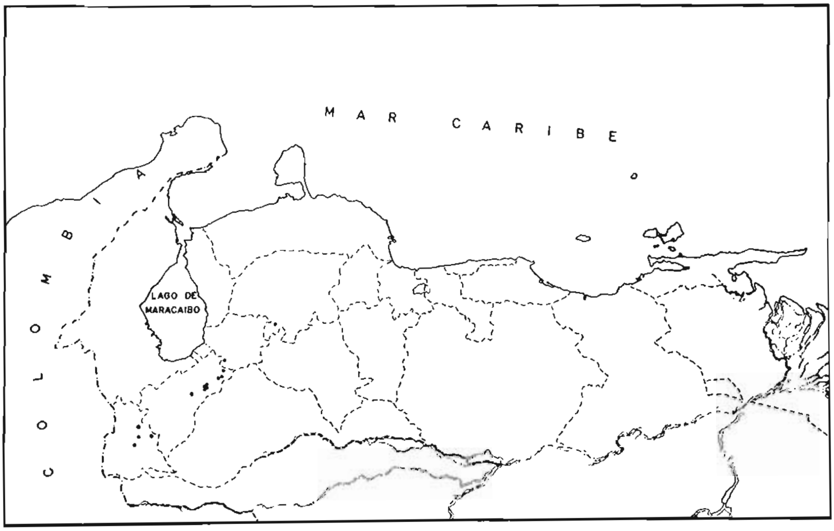

FIG. 34. The distribution of Sabanero.

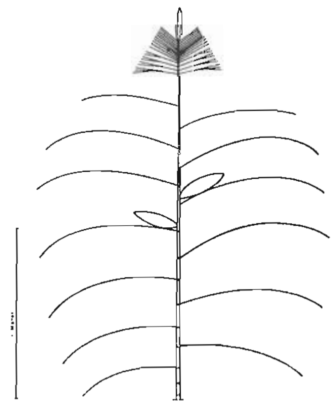

FIG. 35. Plant Diagram of Sabanero.

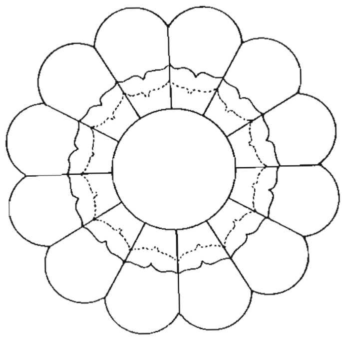

FIG. 36. Ear cross-section diagram of Sabanero.

HUEVITO

Plants. Medium tall; medium early; few tillers; some plant color and pubescence; nodes mostly well exserted; leaves gently arched, narrow to medium width; prominent adventitious roots up to third and fourth nodes; average elevation of typical collections 910 meters; range: 250 to 1,750 meters.

Tassels. Well exserted, fairly open; branches stiff and upright, short to medium long; large sterile zones on some branches; central spikes prominent.

Ears, external characters. Medium length; slender, slightly tapering; 8 to 10 rows, mostly straight, grains wide, rounded, shallow, mostly deep yellow-orange color; some soft flour capping; small barren tip.

Ears, internal characters. Diameter of ear 38.1 mm; diameter of cob 21.7 mm; diameter of rachis 14.4 mm; cob/rachis index 1.51; some cob color; high percentage of glume color.

Discussion. *Huevito,* with slender, cigar-shaped to slightly tapering ears and wide yellow flint grains, is common in the state of Táchira and extends northeastward along the Andes at intermediate elevations. *Pollo* is almost certainly one of its parents. The other probably contributed a tendency toward straight rows and slender tapering ears. This second parent could well have been the Colombian race *Andaquí* (Roberts *et al.,* 1957), which also occurs on the eastern flanks of the Andes but has not been collected in Venezuela. In Táchira, *Huevito* intergrades with the very productive yellow cylindrical dent *Tusón* and may in fact have entered into its ancestry. The name *"Huevito,"* which means "little egg," is applied by farmers in Táchira to this race, perhaps in fanciful allusion to the shape of the ear.

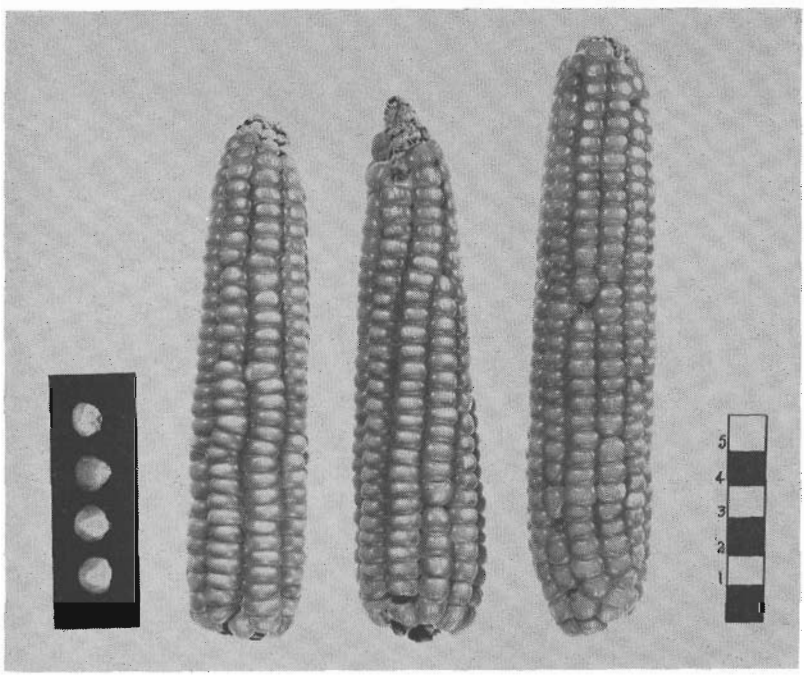

FIG. 37. Representative ears of Huevito. This is a distinctive 8-10 rowed race found in a small area in western Venezuela.

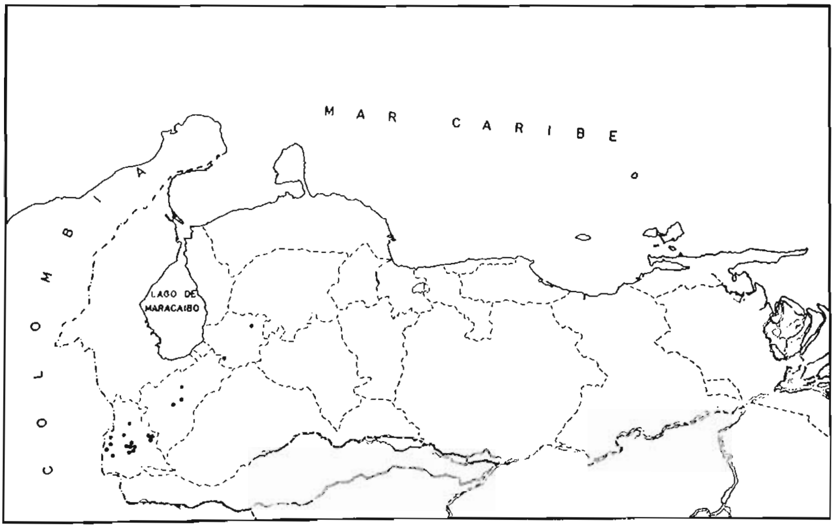

FIG. 38. The distribution of Huevito.

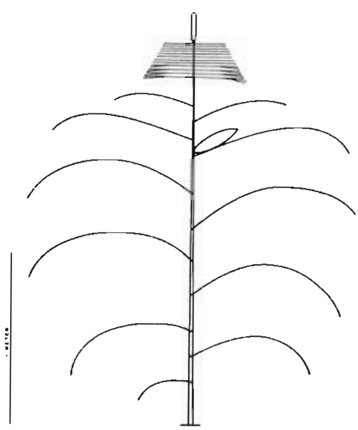

FIG. 39. Plant Diagram of Huevito.

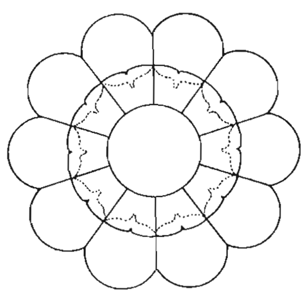

FIG. 40. Ear cross-section diagram of Huevito.

PUYA

Plants. Very tall; most nodes barely exserted; leaves extremely long, at first ascending, then arching downward; some color in plants; strongly pubescent; medium resistance to rust and Helminthosporium; mean altitude of typical collections 121 meters; range 30 to 1,300 meters.

Tassels. Open and well exserted; long stiff branches; many secondaries; central spike prominent.

Ears, external characters. Long cylindrical, tapered somewhat at tip; 10 to 14 rows; grain wide and long, well dented, white to orange yellow endosperm; little pericarp and no aleurone color; considerable cob and midcob color.

Ears, internal characters. Diameter of ear 38.3 mm; diameter of cob 19.4 mm; diameter of rachis 13.6 mm; cob/rachis index 1.42.

Discussion. The Venezuelan collections of *Puya* are remarkably uniform, having 12 to 16 straight rows of wedge-shaped, well dented yellow grains. The cobs are somewhat thicker than those of Colombian *Puya,* and the ears taper less. The distribution of *Puya* in Venezuela is strongly centered around Lake Maracaibo. In Colombia *Puya* extends along the Caribbean coast and up the Magdalena river.

The origin of the hard yellow dents of Colombia, Venezuela, and the West Indies presents one of the most intriguing problems in the field of maize race studies. Because the Arawak had apparently introduced dent corns into the Greater Antilles from South America before the Spanish conquest, the presence of hard yellow dents on the Caribbean coast of South America is probably pre-Columbian. There are, however, no indigenous types of maize in South America from which races like *Puya* can be readily derived. In Mexico indigenous hard dent corns are abundant at all elevations. Races like *Puya,* therefore, may be ancient introductions from the Gulf Coast of Mexico to Colombia and Venezuela, modified there by introgression from such South American races as *Chirimito* and *Canilla Venezolano.*

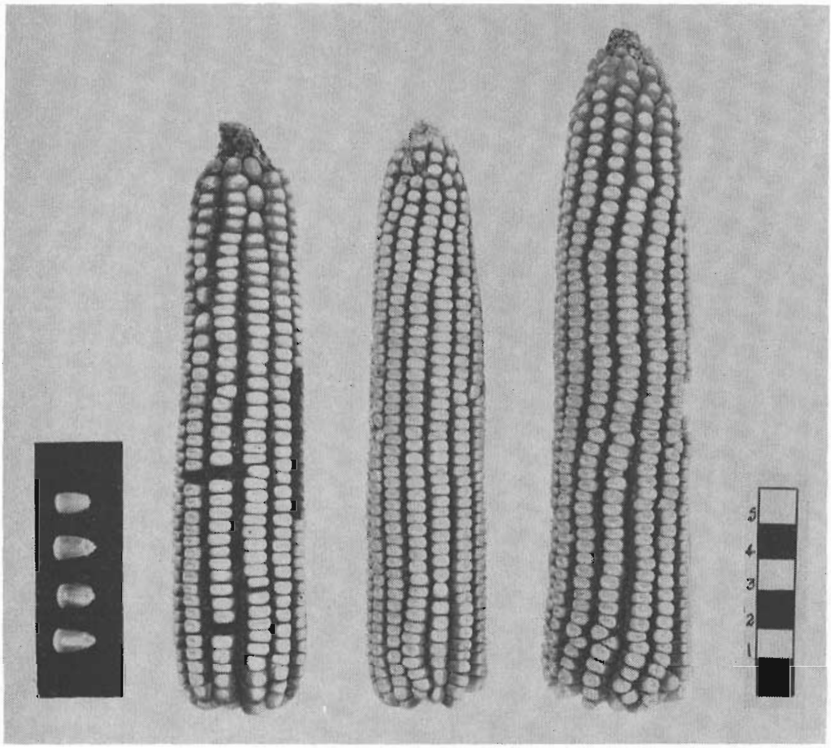

FIG. 41. Representative ears of Puya. This race has a higher row number and is more uniform than the Colombian form.

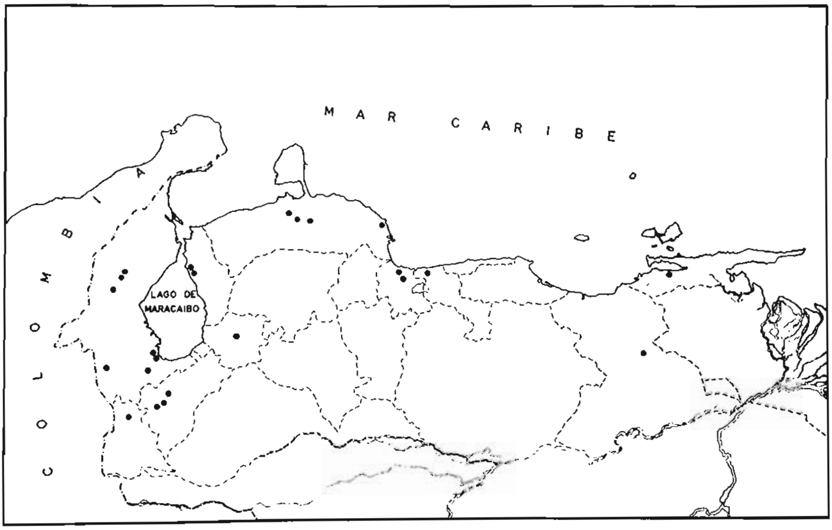

FIG. 42. The distribution of Puya.

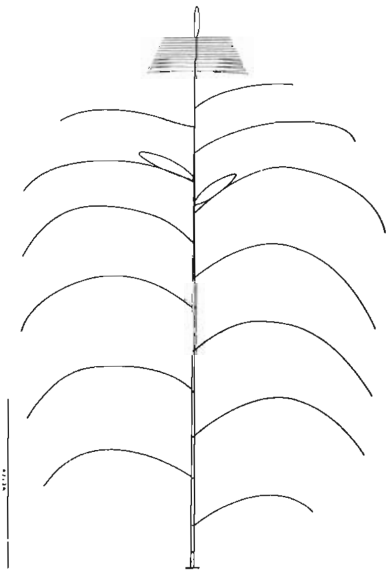

FIG. 43. Plant Diagram of Puya.

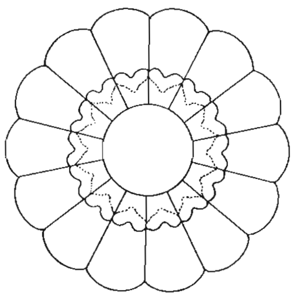

FIG. 44. Ear cross-section diagram of Puya.

TUSÓN

Plants. Medium tall; nodes covered by sheaths below ear, but exserted above; leaves gently arched; ears placed at mid-point of plant; some plants dark green, others purple and sun-red; somewhat susceptible to rust and Helminthosporium. Mean altitude of typical collections 450 meters; range 60 to 760 meters.

Tassels. Very open, with long stiff horizontal branches; central spike inconspicuous.

Ears, external characters. Large, thick, fairly long, cylindrical; 14 to 18 straight rows; barren tips common; grains wide, flat, semident to dent; lemon yellow endosperm, often with red pericarp.

Ears, internal characters. Diameter of ear 47.8 mm; diameter of cob 27.7 mm; diameter of rachis 19.3 mm; cob/rachis index 1.43.

Discussion. This wide-grained yellow cylindrical dent has a rather curious distribution in Venezuela. Its occurrence in the eastern state of Monagas is not unexpected, for according to Brown (1960) *Tusón* is the "dominant race" of the nearby island of Trinidad. In the West Indies *Tusón* also occurs in Cuba, Haiti, Jamaica and the Dominican Republic. *Tusón* has two other centers of distribution in Venezuela—around Lake Valencia near the Caribbean coast and in the state of Táchira, adjacent to Colombia.

Tusón is not a well defined race in Venezuela. It does not possess a really consistent set of associated characteristics by which it can be readily distinguished from other races, and its geographical distribution is spotty. On the other hand, the few good Venezuelan collections represent an extension of the range of this race which, according to Brown (1960) "possesses exceptional vigor and yielding capacity . . . it is without doubt the most promising source of germ-plasm in the West Indies today." Brown suggests that it "probably arose out of crosses between *Coastal Tropical Flint* and some unknown dent corn." In Venezuela *Tusón* does in fact intergrade with *Costeño* and *Común* and with dents which may derive from early introductions of *Tuxpeño* or a similar Mexican dent. In Táchira, however, *Tusón* intergrades with the wide-grained yellow flint *Huevito*. This raises the possibility that *Tusón* may be basically a Mexican dent introduced into the Lake Maracaibo region in pre-Columbian times and subsequently modified by introgression of Andean germ plasm.

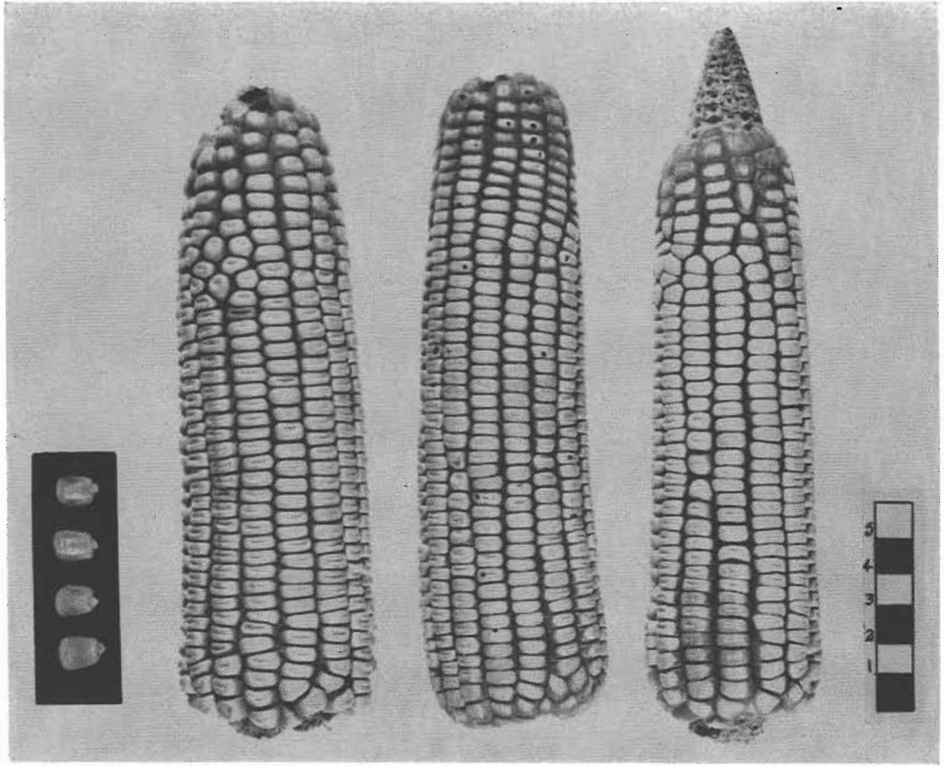

FIG. 45. Representative ears of Tusón.

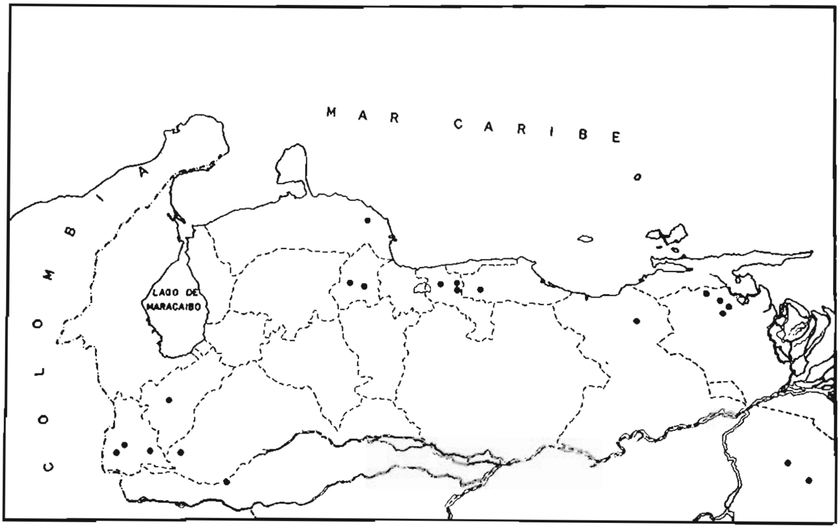

FIG. 46. The distribution of Tusón.

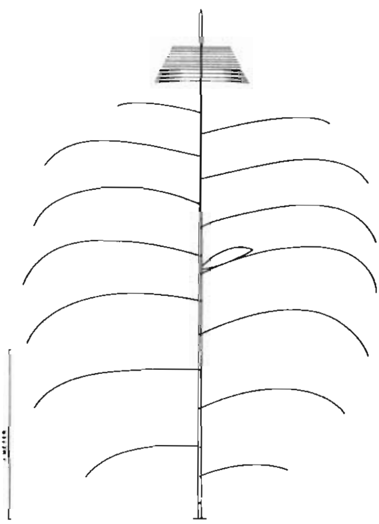

FIG. 47. Plant Diagram of Tusón.

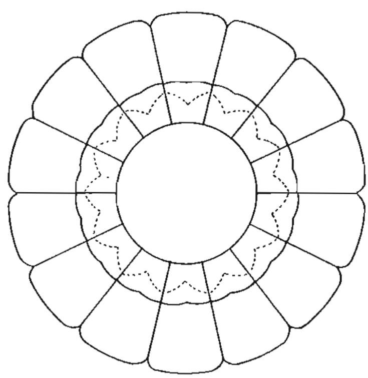

FIG. 48. Ear cross-section diagram of Tusón.

CUBA YELLOW FLINT

Plants. Relatively tall, with narrow, arching leaves; type not too well defined and usually found mixed with *Tusón* or *Tuxpeño* races; some sun-red and purple color; strongly pubescent; fairly resistant to rust and Helminthosporium; mean altitude of typical collections 185 meters; range 100 to 390 meters.

Tassels. Well exserted; branches long, stiff and mostly ascending; central spike shorter than most tassel branches; secondary branches numerous.

Ears, external characters. Relatively thin, cylindrical to tapering; 12 to 14 straight to slightly spiraling rows; kernels medium size, shallow, orange yellow flint with occasional flour capping. Some cob and glume colors.

Ears, internal characters. Diameter of ear 40.4 mm; diameter of cob 22.6 mm; diameter of rachis 15.8 mm; cob/rachis index 1.43.

Discussion. Cuba Yellow Flint occurs in Venezuela chiefly as a flinty segregate of *Costeño,* and our few relatively unmixed collections with orange endosperm are widely scattered. They may represent modern introductions (either from Cuba or Brazil) or they could be relicts of orange *Cateto* flints that may have extended into Venezuela in pre-Columbian times. "*Northern Cateto Flints*" have been collected recently in the Guianas and the Amazon area (Brieger *et al.,* 1958), but they were not found in the part of Venezuela adjacent to British Guiana.

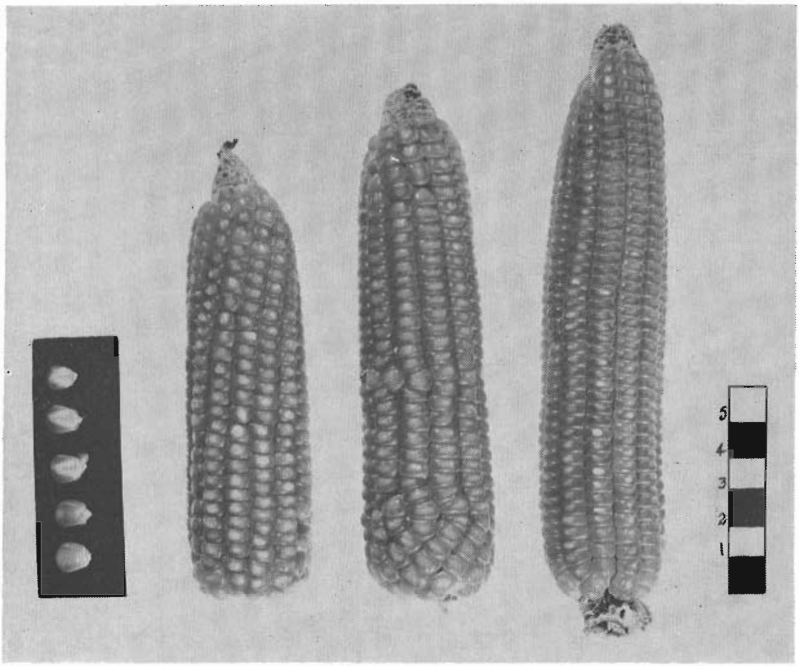

FIG. 49. Representative ears of Cuba Yellow Flint.

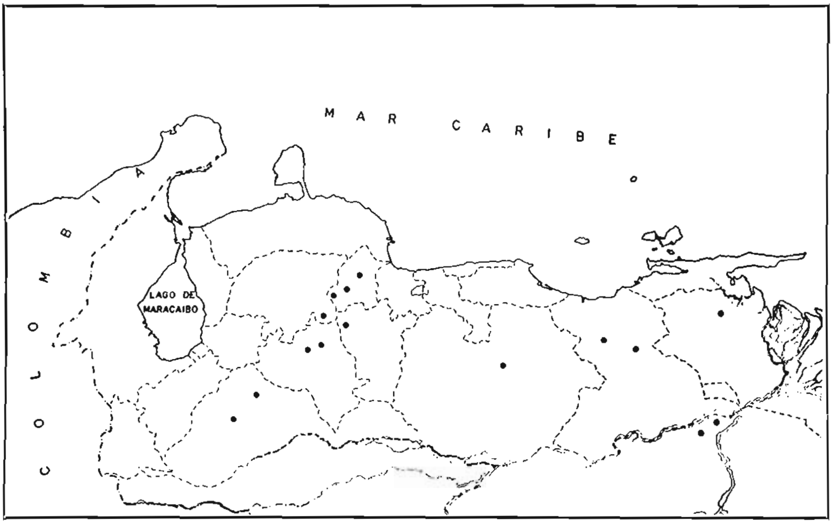

FIG. 50. The distribution of Cuba Yellow Flint.

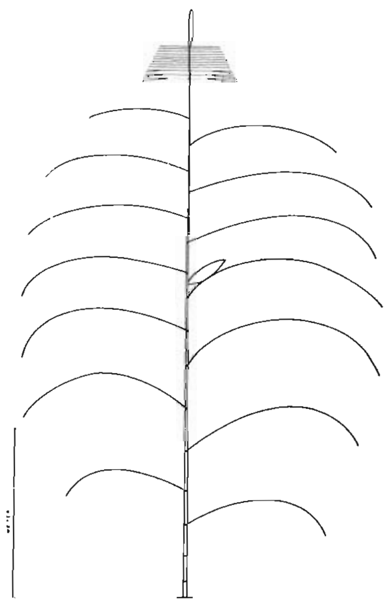

FIG. 51. Plant Diagram of Cuba Yellow Flint.

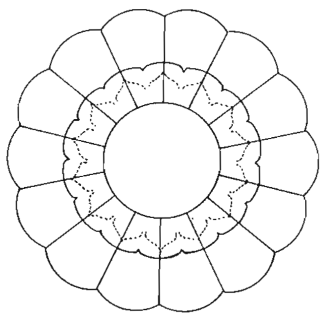

FIG. 52. Ear cross-section diagram of Cuba Yellow Flint.

CHANDELLE

Plants. Tall; leaves arching to somewhat stiff; nodes well exserted; considerable plant color, purple and sun-red; few tillers; some pubescence; resistant to rust and Helminthosporium; mean elevation of typical collections 305 meters; range 30 to 1,000 meters.

Tassels. Dense, with strongly arching, short branches; many secondaries.

Ears, external characters. Ear long, slender, flexible; soft cap on grain or dented; some cob and glume color; white and yellow endosperm; similar to *Puya*, but grains harder and ear more slender.

Ears, internal characters. Average ear diameter 36.4 mm; average cob diameter 19.6 mm; average rachis diameter 12.5 mm; cob/rachis index 1.52.

Discussion. The distribution in Venezuela of *Chandelle*, although somewhat dispersed, tends to be centered between Lake Maracaibo and the Caracas River. It is probably no coincidence that Arawakan tribes were concentrated in this region before the Spanish conquest. The Arawak entered the West Indies from South America and reached the island of Cuba a few centuries before Columbus (Rouse, 1948). *Chandelle* is abundant in eastern Cuba and Haiti, and also occurs in the Dominican Republic and Trinidad (Hatheway, 1957; Brown, 1960), but there is little doubt that it originated in Venezuela. One parent was certainly *Canilla Venezolano;* the other was a slender yellow dent with a somewhat lower ear row number—possibly the form of *Puya* common around Lake Maracaibo. Brown (1960) states that Antillean *Chandelle* is found in two forms, a semi-flint and a dent. These probably represent mere segregations of the parental Venezuelan races, *Canilla* and *Puya.*

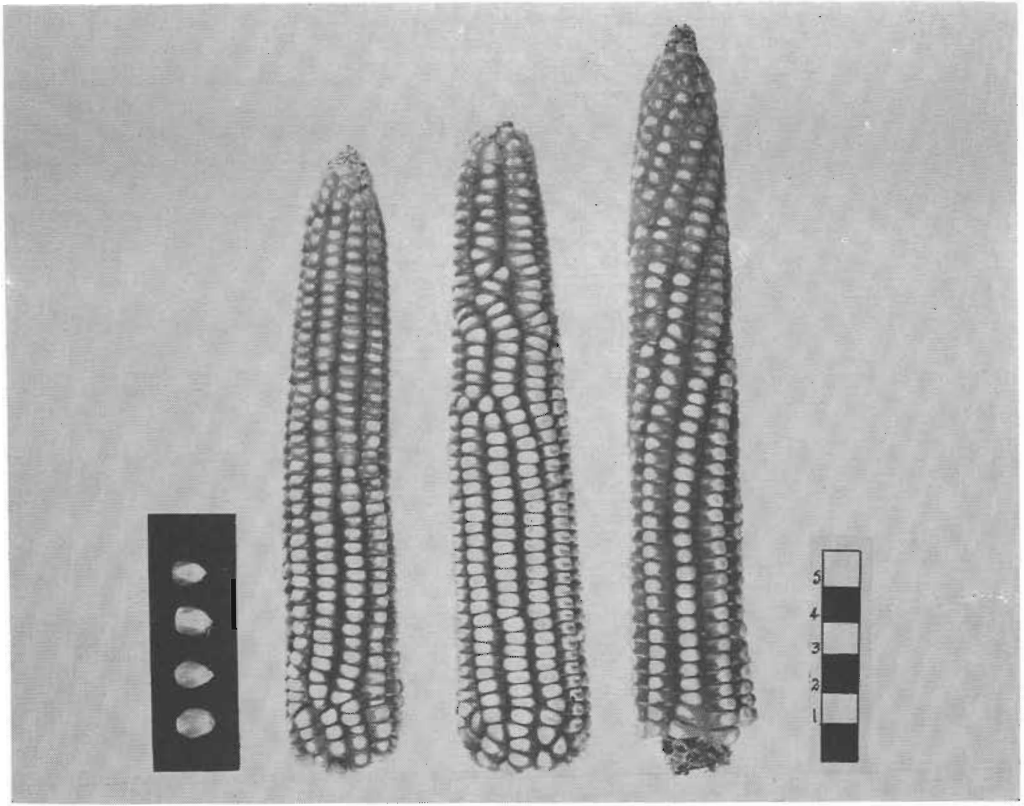

FIG. 53. Representative ears of Chandelle. This race is quite similar to the Caribbean form with low row number and flexible cobs.

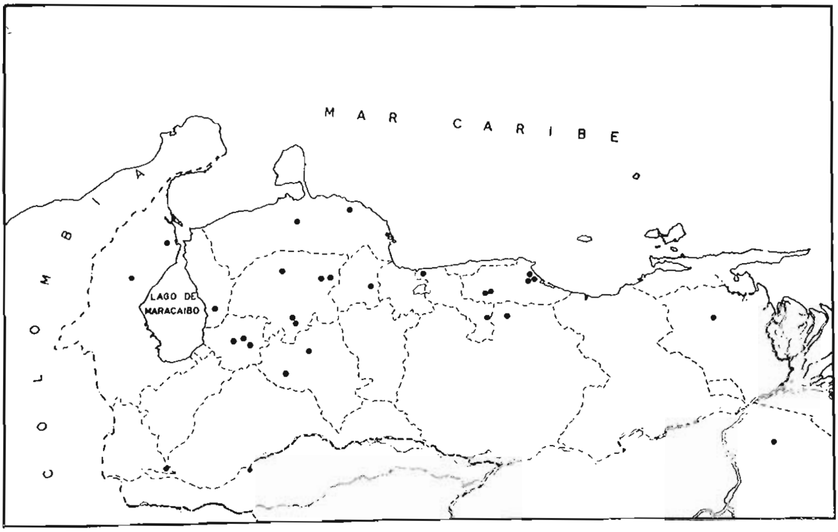

FIG. 54. The distribution of Chandelle.

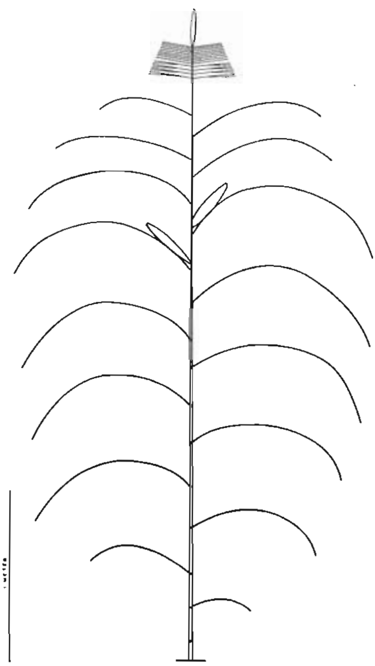

FIG. 55. Plant Diagram of Chandelle.

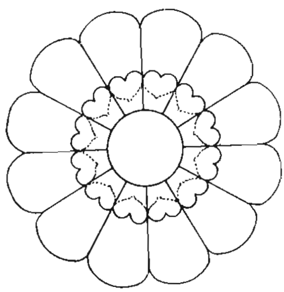

FIG. 56. Ear cross-section diagram of Chandelle.

COSTEÑO

Plants. Medium height; wide wavy leaves; sturdy stalks; ear slightly above midpoint; some sun-red and purple plant color; strongly pubescent; susceptible to rust and Helminthosporium; mean altitude of typical collections 290 meters; range 10 to 1,500 meters.

Tassels. Well exserted; conical with stiff to slightly arching short branches; central spike prominent. Some collections have exceedingly long tassels with open drooping branches.

Ears, external characters. Short, stubby, thick cylindrical, 12 to 14 straight rows; generally irregular at the base; kernels wide, flat; white and orange-yellow endosperm, some pericarp color; kernels flinty with soft caps; some cob and mid-cob color.

Ears, internal characters. Average diameter of ear 45.4 mm; average cob diameter 26.2 mm; average rachis diameter 18.8 mm; cob/rachis index 1.39.

Discussion. Costeño is one of the most common and widespread races of maize in the Caribbean lowlands of Venezuela and Colombia. At slightly higher elevations in both countries it is replaced by *Común,* a somewhat longer-eared semi-flint race. Students of West Indian maize (Hatheway, 1957; Brown, 1960) did not distinguish the two types, but the *"Coastal Tropical Flint"* described by Brown and earlier by Cutler (1946) resembles *Común* more than it does the stubbier *Costeño.* Roberts *et al.* (1957) suggested that *Costeño* might have originated in Venezuela "from a cross between a yellow flint and a white cylindrical dent race." Since the postulated yellow flint parent is nowhere common in Venezuela, this hypothesis requires modification. A possible white flint parent, the stubby eared conical race *Guaribero,* is common in eastern Venezuela, however, and crossed with either of the yellow dents *Puya* or *Chandelle* could have given rise to *Costeño* and to the longer eared *"Coastal Tropical Flint."* In fact, intergrading series of this kind are so common in Venezuela that it is often difficult to distinguish among *Guaribero, Costeño, Común* and *Puya.*

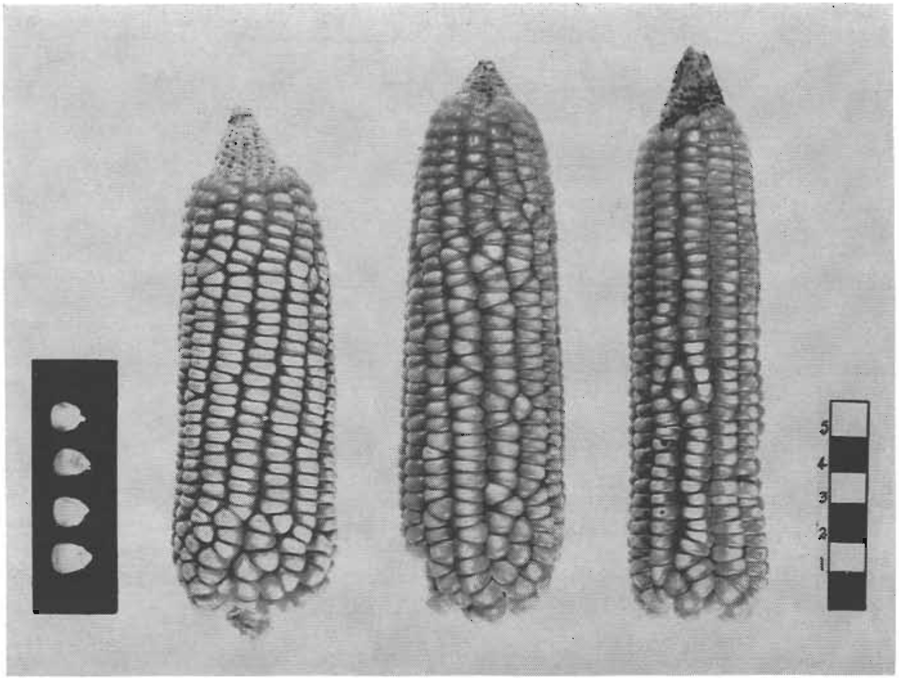

Fig. 57. Representative ears of Costeño. This race occurs with white and yellow endosperm.

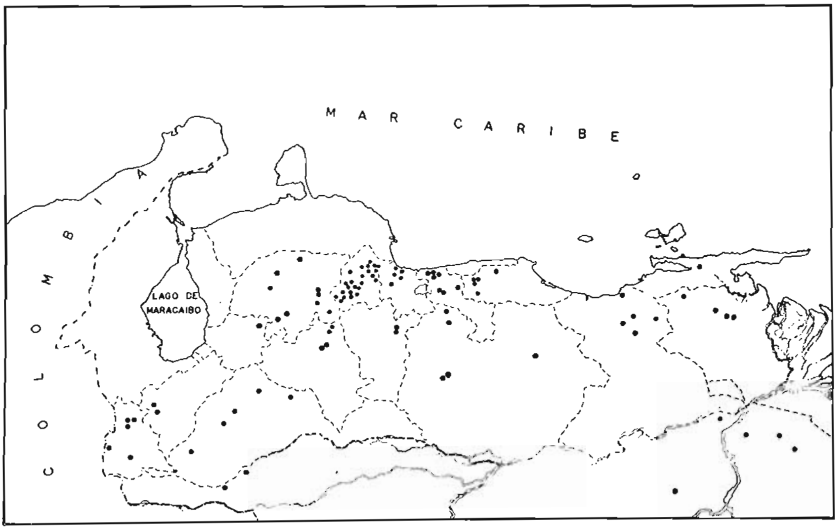

FIG. 58. The distribution of Costeño.

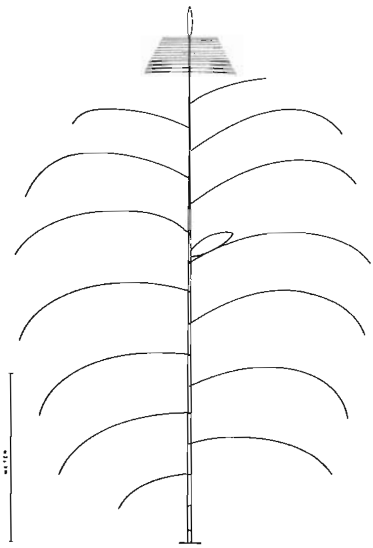

FIG. 59. Plant Diagram of Costeño.

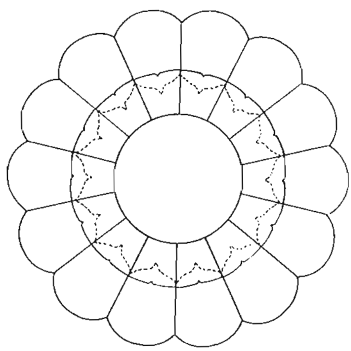

FIG. 60. Ear cross-section diagram of Costeño.

PUYA GRANDE

Plants. Tall; nodes barely exserted; long internodes above ear which is placed high on plant; leaves very long, stiff, ascending with slight arch; some sun-red and purple plant color; highly pubescent; relatively resistant to rust and Helminthosporium. Mean altitude of typical collections 247 meters; range 60 to 660 meters.

Tassels. Large, dense, well exserted; long stiff primary branches with long sterile zones; numerous secondaries.

Ears, external characters. Very long ears; cylindrical; 14 to 18 straight ridged rows; grains dent to semident, with white or yellow endosperm and occasional red pericarp; cobs mostly red and glumes often colored.

Ears, internal characters. Average diameter of ear 46.1 mm; average cob diameter 24.2 mm; average rachis diameter 16.8 mm; cob/rachis index 1.44.

Discussion. Puya Grande, a semi-dent maize with long, slender slightly tapering ears, is abundant in Venezuela's corn belt along the eastern flanks of the Andes. It also occurs in the state of Monagas, near the delta of the Orinoco river. Considerable mixing with an improved form of the Mexican race *Tuxpeño* ("Sicarigua") has occurred, giving rise to an extremely vigorous, highly productive type of maize. *Puya Grande,* which is commonly called "Chuco" in western Venezuela, also occurs in eastern Colombia (Roberts *et al.* 1957).

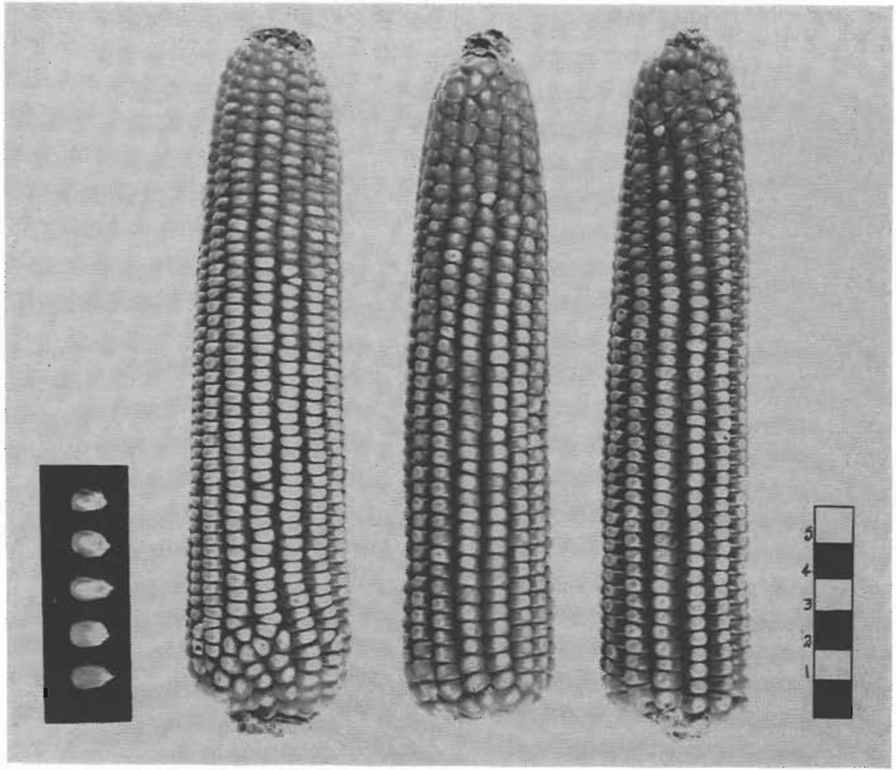

FIG. 61. Representative ears of Puya Grande. This race occurs with white and yellow endosperm.

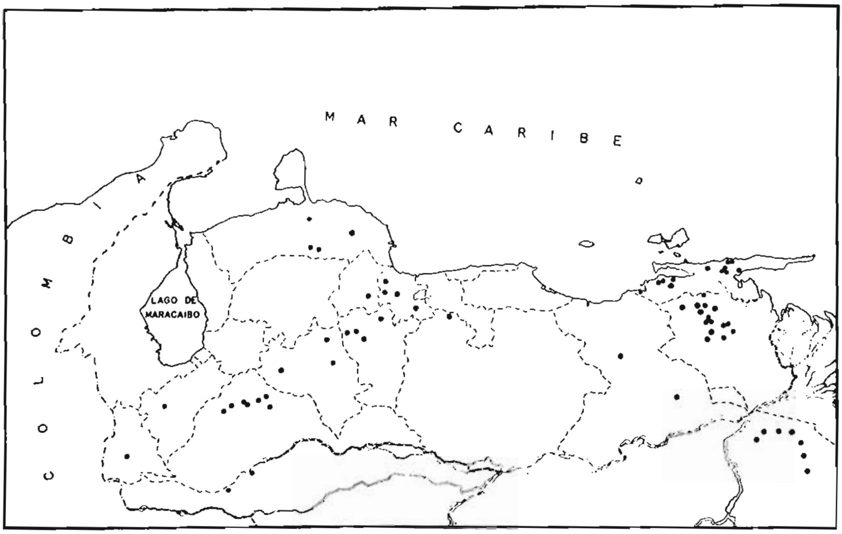

FIG. 62. The distribution of Puya Grande.

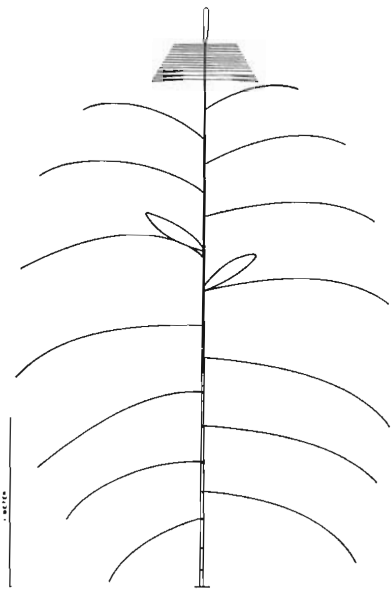

FIG. 63. Plant Diagram of Puya Grande.

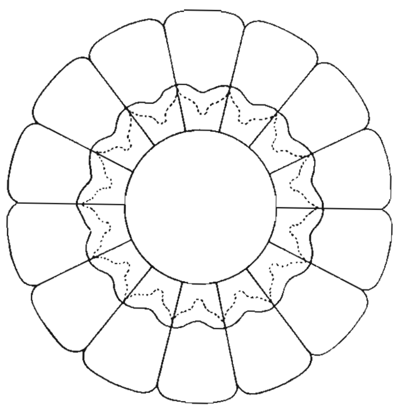

FIG. 64. Ear cross-section diagram of Puya Grande.

TUXPEÑO

Plants. Tall, with stout stems; adventitious roots common at first and second nodes; nodes exserted, showing sun-red and some purple plant color; leaves arching, deeply grooved at base, dark green, wide and long; highly resistant to rust and Helminthosporium; mean altitude of typical collections 330 meters; range 40 to 1,000 meters.

Tassels. Well exserted; long, stiff, somewhat arched branches; prominent sterile zones, and inconspicuous central spikes.

Ears, external characters. Long to heavy, thick, cylindrical, strongly dented to semi-flint white grains; 12 to 16 rows, mostly straight but sometimes slightly spiralling; cobs commonly red.

Ears, internal characters. Average ear diameter 48.7 mm; average diameter of cob 27.9 mm; average diameter of rachis 19.9 mm; cob/rachis index 1.40.

Discussion. The very productive white cylindrical dent *Tuxpeño* is a Mexican race (Wellhausen *et al.*, 1952) which has become the dominant commercial maize of many tropical countries in post-Conquest times. In Venezuela *Tuxpeño* is commonly known as "Sicarigua," after a town in the state of Lara east of Lake Maracaibo, where an improved form of *Tuxpeño* became established some years ago. From Sicarigua, *Tuxpeño* spread east to the corn belt in the states of Portuguesa, Barinas and Cojedes, where it has introgressed extensively into the semi-flint races *Común, Costeño,* and *Puya Grande.* The resulting mixtures are not easy to classify, but they include some of the most promising tropical breeding material known. Certain segregating forms are recognized by the local farmers. One of these is "Pailón," a white cylindrical semi-dent with an exceptionally thick cob.

It seems possible that *Tuxpeño* (or a related Mexican dent) may have been introduced into Venezuela in the pre-Conquest period. *Puya, Puya Grande, Tusón* and *Chandelle* are all well established dent or semi-dent races that may have Mexican affinities. The uniformity and stability of *Puya* around Lake Maracaibo, for example, is in marked contrast to the variability of the maize in the corn belt states of Barinas, Portuguesa and Cojedes, where introgression from *Tuxpeño* has been important only recently. Therefore, if Mexican dent germplasm is involved in the ancestry of *Puya* and other native dent races, the hybridization must have occurred some time ago.

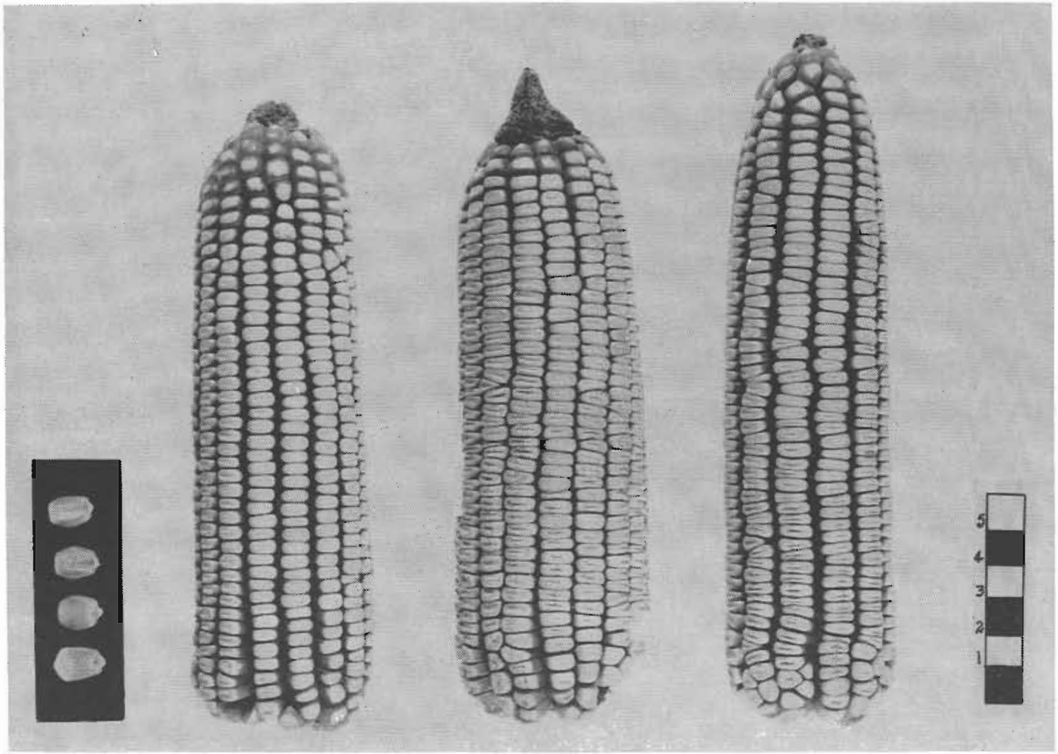

Fig. 65. Representative ears of Tuxpeño. This form of Tuxpeño is commonly called Sicarigua in Venezuela.

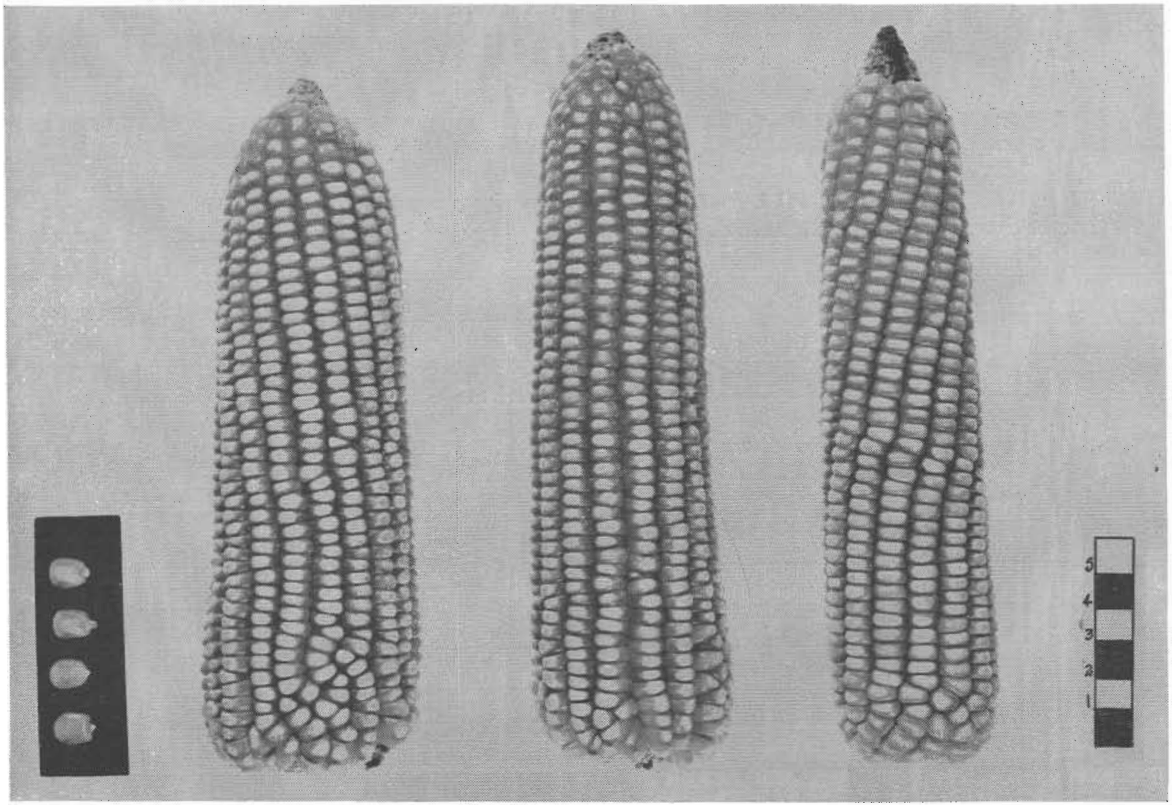

FIG. 66. Representative ears of Tuxpeño. This form of the Tuxpeño race is commonly called Pailón in Venezuela. It is difficult to separate this type from Puya Grande.

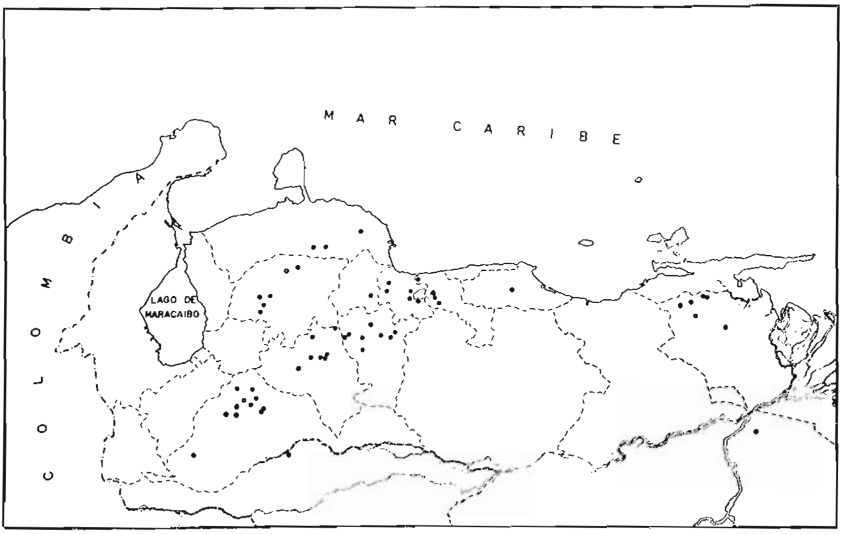

FIG. 67. The distribution of Tuxpeño.

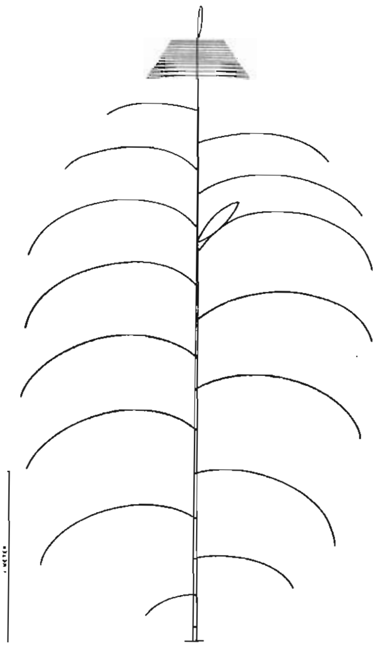

FIG. 68. Plant Diagram of Tuxpeño.

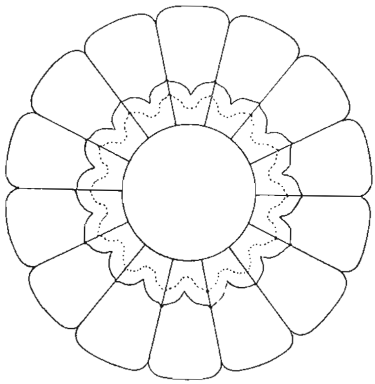

FIG. 69. Ear cross-section diagram of Tuxpeño.

COMÚN

Plants. Medium tall; no tillers; long leaves of medium width; plant color medium to strong; somewhat pubescent; moderately susceptible to rust and Helminthosporium; average elevation of typical collections 700 meters; range 340 to 1,400 meters.

Tassels. Long, with many branches; secondaries and tertiaries numerous; somewhat silky appearance; considerable glume color.

Ears, external characters. Medium long, thick, nearly cylindrical; slight taper to tip; 10 to 16 rows; shank of intermediate length; medium number of husks; mid-cob color high; kernels wide, rounded, with some soft capping; aleurone and pericarp colors infrequent; yellow and white endosperm.

Ears, internal characters. Average ear diameter 41.0 mm; average cob diameter 22.4 mm; average rachis diameter 15.7 mm; cob/rachis index 1.42.

Discussion. Común replaces *Costeño* at elevations of over 700 meters in the Andes. It differs from *Costeño* chiefly in its longer ears and in its adaptation to slightly cooler, moist situations—*Costeño* is a corn of the very hot, often dry Caribbean coast. *Común* is not so common in Venezuela as in Colombia, and has been much affected by introgression from improved varieties of the productive Mexican race *Tuxpeño* as well as by *Puya Grande* and *Tusón.*

Because ears of the Colombian race *Común* were recognized among the Venezuelan collections only in the final stages of this study, plant data are incomplete; a plant diagram is not presented.

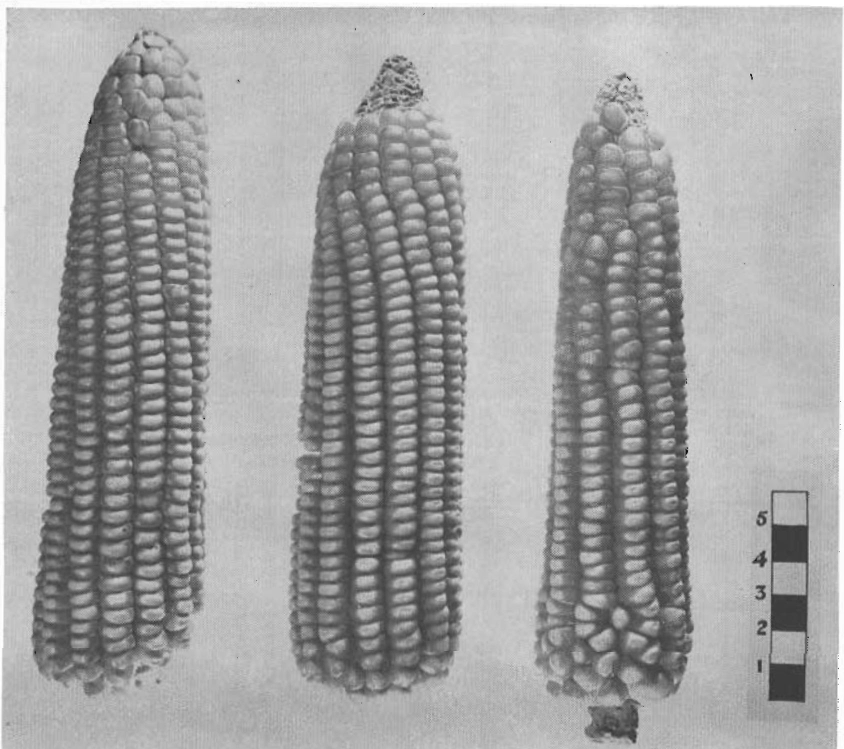

FIG. 70. Representative ears of Común. This race occurs with white and yellow endosperm.

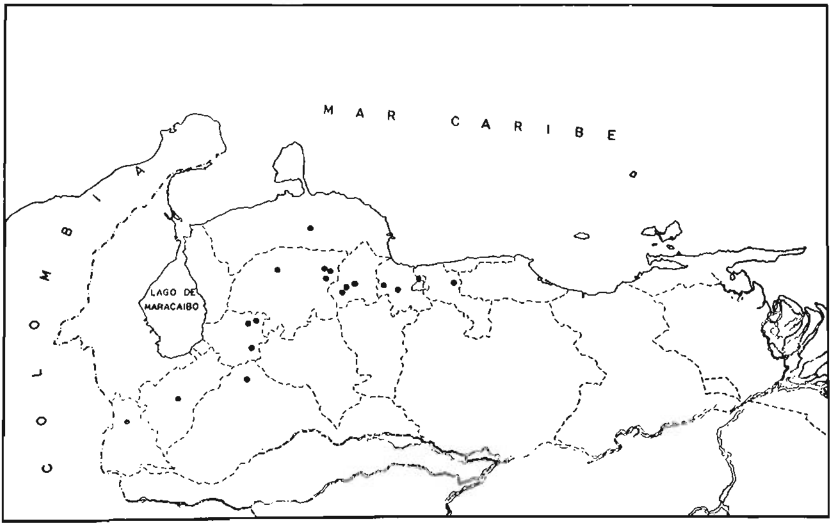

FIG. 71. The distribution of Común.

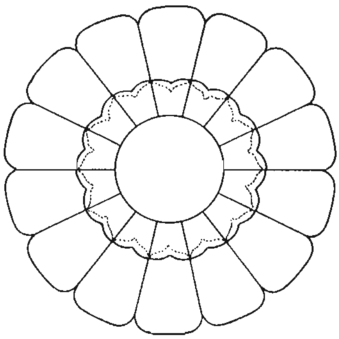

FIG. 72. Ear cross-section diagram of Común.

NEGRITO

Plants. Medium to tall, early; no tillers; leaves short; plant color and pubescence intermediate; somewhat susceptible to races of corn rust and Helminthosporium; average elevation of typical collections 100 meters; range 0 to 250 meters.

Tassels. Short, intermediate number of branches; few secondary branches.

Ears, external characters. Relatively short, thick cylindrical to slightly tapering; barren tips common; average row number 12 to 16; high mid-cob color; high glume color; kernels rounded; almost all with blue aleurone; red pericarp color common.

Ears, internal characters. Average ear diameter 41.2 mm; average cob diameter 23.2 mm; average rachis diameter 18.2 mm; cob/rachis index 1.54.

Discussion. In Venezuela, as in Colombia, *Negrito* occurs sporadically on the hot northern coastal plain. Like *Cariaco,* it belongs to the complex of lowland soft flour races of the South American Indians (Brieger *et al.*, 1958). Because of its purple aleurone color, *Negrito* may once have been associated with some special ceremonial use. In Colombia, *Negrito* is still used in the preparation of a bread called "Bollo" (Roberts *et al.*, 1957).

Venezuelan Negrito may have been influenced somewhat by introgression from *Güirua,* which also has blue aleurone, and from *Costeño.* Venezuelan plants are taller than those from Colombia.

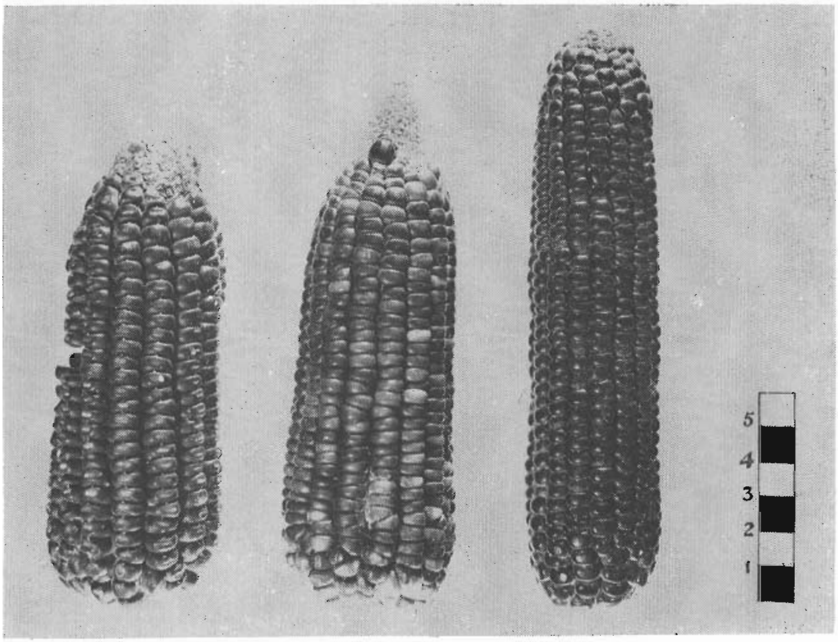

Fig. 73. Representative ears of Negrito.

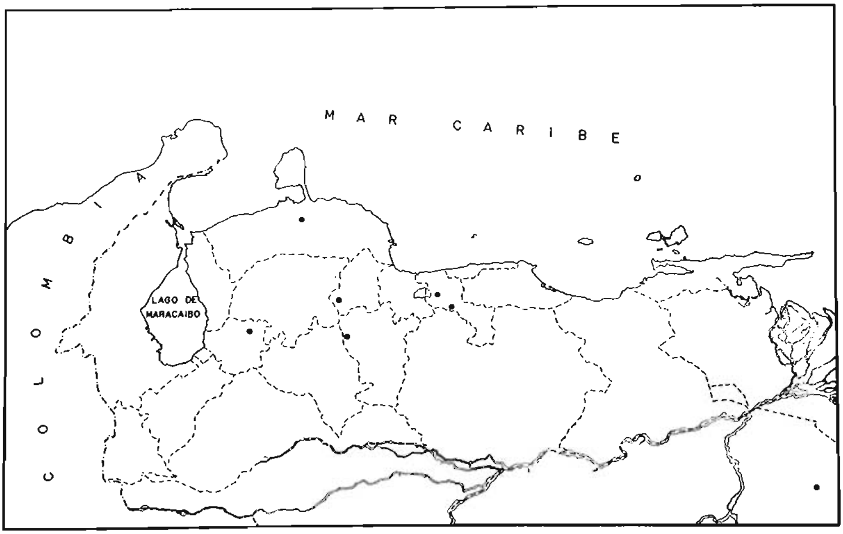

FIG. 74. The distribution of Negrito.

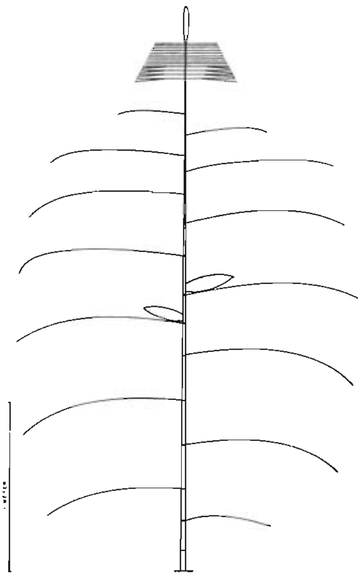

FIG. 75. Plant Diagram of Negrito.

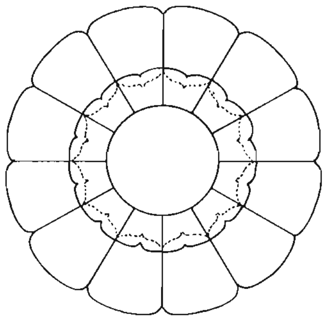

FIG. 76. Ear cross-section diagram of Negrito.

CACAO

Plants. Similar to *Común*, medium tall, no tillers; considerable plant color and pubescence; fairly resistant to rust and Helminthosporium. Only one collection made, at 220 meters elevation.

Tassels. Long, with many branches; high percentage of secondaries and tertiaries.

Ears, external characters. Medium long, thick, slightly tapered, with 12 to 16 rows. Kernels soft, wide, flat, slightly dented, the single collection with much bronze aleurone and pericarp color.

Ears, internal characters. Average ear diameter 45.6 mm; average cob diameter 28.1 mm; average rachis diameter 18.2 mm; cob/rachis index 1.54.

Discussion. In Venezuela *Cacao* is known from only a single collection in the Andean state of Mérida. In Colombia, where it is much more common, *Cacao* is centered in the Department of Santander, but it also occurs in Santander del Norte, adjacent to Venezuela. The name *Cacao* derives from the resemblance of the brown kernels commonly found in this race to the roasted seeds of the cocoa tree.

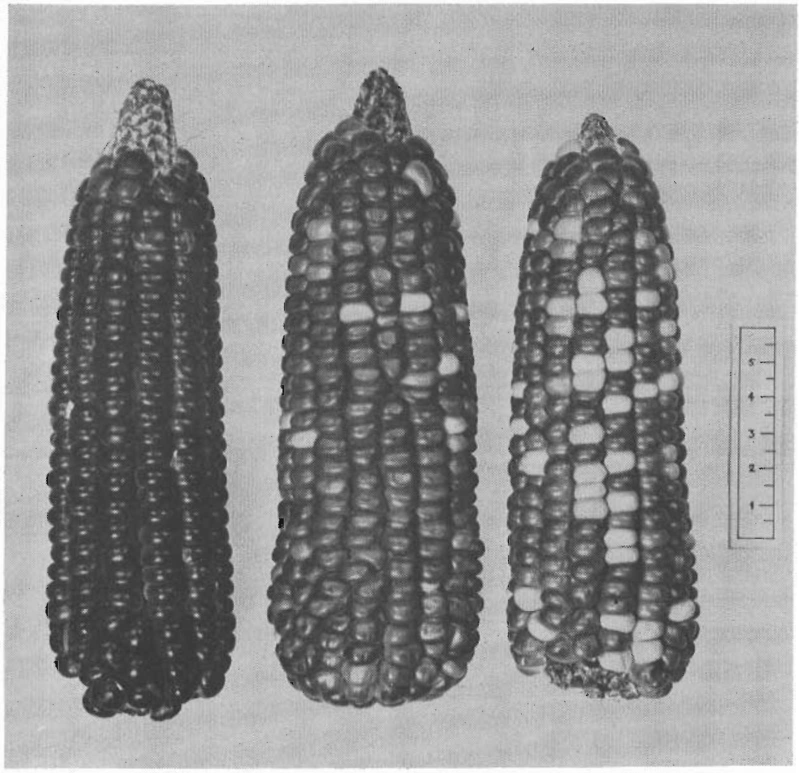

FIG. 77. Representative ears of Cacao.

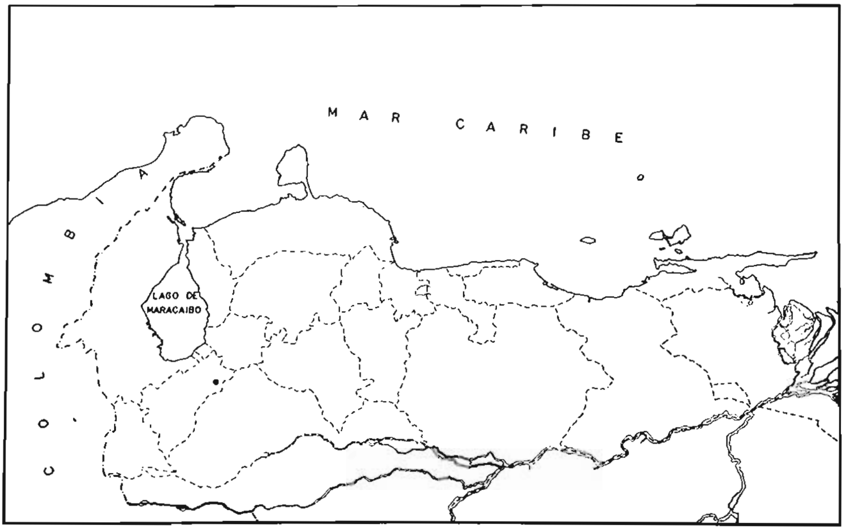

Fig. 78. The distribution of Cacao.

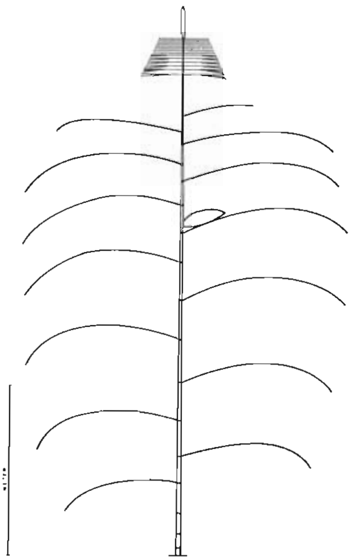

Fig. 79. Plant Diagram of Cacao.

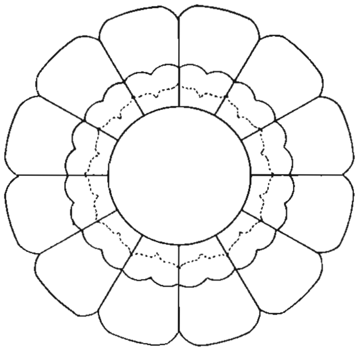

Fig. 80. Ear cross-section diagram of Cacao.

SUMMARY

1. 19 races of Venezuelan maize are described in the present report. This classification is based on the study of 685 accessions, almost all of which were collected north of the Orinoco River.

2. 10 Venezuelan races had been recognized previously in Colombia, three in the West Indies, and one in Mexico. The latter is a modern commercial introduction which has introgressed into many of the native races of maize, giving rise to several extremely productive incipient varieties.

3. Five races are described for the first time. One of these is restricted to the Andes of western Venezuela at intermediate elevations. The remaining four are concentrated in the former Carib area between Caracas and the delta of the Orinoco.

4. General descriptions, ear photographs, distribution maps, plant and ear diagrams, and tabular data on ears, plants, tassels, and physiological characters are presented for each race.

5. Data are presented on maize cultivation in Venezuela. Because of the extensive hybridization that has occurred between high-yielding West Indian, Mexican, and South American races of maize, Venezuela is an important gene pool and therefore must be considered an extremely promising source of material for further corn improvement.

LITERATURE CITED

Acosta Saignes, Miguel. 1946. Los Caribes de la Costa Venezolana. *Acta Antropologica* (Mexico). 61 pp.

Brieger, F. G., J. T. A. Gurgel, E. Paterniani, A. Blumenschein, and M. R. Alleoni, 1958. *Races of Maize in Brazil and other Eastern South American Countries.* Natl. Acad. Sci.-Natl. Res. Council Publ. No. **593**.

Brown, W. L., 1960. *Races of Maize in the West Indies.* Natl. Acad. Sci.-Natl. Res. Council Publ. No. **792**.

Cutler, H. C. 1946. Races of Maize in South America. *Bot. Mus. Leafl.* Harvard Univ. **12**: 257-291.

Grobman, A., W. Salhuana, and R. Sevilla, in collaboration with P. C. Mangelsdorf. 1961. *Races of Maize in Peru.* Natl. Acad. Sci.-Natl. Res. Council Publ. No. **915**.

Gumilla, Padre Joseph. 1791. *Historia Natural, Civil y Geográfica de las Naciones Situadas en las Riberas del Rio Orinoco.* 2 vol. Barcelona.

Hatheway, W. H. 1957. *Races of Maize in Cuba.* Natl. Acad. Sci.-Natl. Res. Council Publ. No. **453**.

Howard, G. D. 1943. Excavations at Ronquín, Venezuela. Yale Univ. Publ. in Anthropology No. **28**: 1-90.

Jahn, A. 1927. *Los Aborígenes del Occidente de Venezuela.* Caracas. 416 pp.
Kidder, Alfred II. 1944. Archeology of Northwestern Venezuela. *Peabody Mus. Harvard Univ. Pap.* **26**: 1-78.
Kidder, Alfred II. 1948. The Archeology of Venezuela. Handbook of South American Indians **4**: 413-438. Bull. **143**, Bur. of Amer. Ethnology.
Kirchhoff, Paul. 1948. The Otomac. Handbook of South American Indians **4**: 439-444. Bull. **143**, Bur. of Amer. Ethnology.
Latorre, G. 1919. Relaciones Geográficas de Indias. Publ. del Centro Oficial de Estudios Americanistas de Sevilla. Biblioteca Colonial Americana. Vol. 3.
Metraux, Alfred, and Paul Kirchhoff. 1948. The Northeastern Extension of Andean Culture. Handbook of South American Indians **4**: 349-368. Bull. **143**, Bur. of Amer. Ethnology.
Osgood, Cornelius, and G. D. Howard. 1943. An Archeological Survey of Venezuela. Yale Univ. Publ. in Anthropology No. **27**: 1-148.
Pittier, H. F. 1932. *Classificación Natural de las Plantas con Especial Mención de las Familias más Importantes de la Flora de Venezuela y de las Especies de Interés Económico.* Caracas.
Ramírez E., Ricardo, D. H. Timotby, E. Díaz B., and U. J. Grant, in collaboration with G. E. Nicholson, E. Anderson and W. L. Brown. 1960. *Races of Maize in Bolivia.* Natl. Acad. Sci.-Natl. Res. Council Publ. No. **747**.
Roberts, L. M., U. J. Grant, R. Ramírez E., W. H. Hatheway, and D. L. Smith, in collaboration with P. C. Mangelsdorf. 1957. *Races of Maize in Colombia.* Natl. Acad. Sci.-Natl. Res. Council. Publ. No. **510**.
Rouse, Irving. 1948. The Carib. Handbook of South American Indians **4**: 457-565. Bull. **143**, Bur. of Amer. Ethnology.
Steward, J. H. 1948. The Circum-Caribbean Tribes: an introduction. Handbook of South American Indians **4**: 1-41. Bull. **143**, Bur. of Amer. Ethnology.
Steward, J. H. Ed. 1950. Handbook of South American Indians, Vol. 6, Map 18. Bull. **143**, Bur. of Amer. Ethnology.
Steward, J. H., and L. C. Faron. 1959. Native Peoples of South America. New York.
Timothy, D. H., B. Peña V., and R. Ramírez E., in collaboration with W. L. Brown and E. Anderson. 1961. *Races of Maize in Chile.* Natl. Acad. Sci.-Natl. Res. Council Publ. No. **847**.
Timothy, D. H., W. H. Hatheway, U. J. Grant, M. Torregroza C., D. Sarria V., and D. Varela A. 1963. *Races of Maize in Ecuador.* Natl. Acad. Sci.-Natl. Res. Council Publ. No. **975**.
Wellhausen, E. J., L. M. Roberts, and E. Hernández X., in collaboration with P. C. Mangelsdorf. 1952. *Races of Maize in México.* Bussey Institution, Harvard Univ.
Wellhausen, E. J., A. Fuentes O., and A. Hernández C., in collaboration with P. C. Mangelsdorf. 1957. *Races of Maize in Central America.* Natl. Acad. Sci.-Natl. Res. Council Publ. No. **511**.

APPENDIX

TABLE 1. Area and Production of Maize in Venezuela, 1958

Departments	*Area Hectares*	*Production Metric Tons*
Anzoateguí	17,851	30,590
Apure	1,156	1,419
Aragua	9,038	12,196
Barinas	9,450	11,602
Bolívar	3,123	4,417
Carabobo	9,452	12,212
Cojedes	13,500	24,600
Falcón	21,351	23,038
Guárico	31,830	34,187
Lara	15,615	16,424
Mérida	6,352	5,271
Miranda	16,170	16,205
Monagas	12,260	15,764
Nueva Esparta	—	—
Portuguesa	42,415	55,328
Sucre	16,020	14,864
Táchira	10,033	9,889
Trujillo	21,355	19,394
Yaracuy	12,470	14,484
Zulia	28,050	35,722
Total	297,491	357,606

Source: Ministerio de Agricultura y Cría, Venezuela.

TABLE 2. Races of Maize of Venezuela Compared in Characters of the Plants

Races	Height (cm.)		Stem Diameter (mm.)		Leaves					No. Tillers
	Plants	Ears	Maximum	Minimum	Ave. No.	No. Above Ear	Length	Width	Venation Index	
Chirimito	199.0	153.7	22.4	20.9	15	5	95.2	9.8	2.7	0.4
Aragüito	155.8	145.6	20.0	18.6	17	6	74.5	8.2	2.7	0.5
Pollo	137.5	105.5	16.9	15.1	11	4	66.6	6.6	3.1	0.0
Canilla Venezolano	248.0	193.6	27.3	25.3	17	7	107.3	10.5	2.5	0.1
Pira	234.0	188.0	24.2	22.7	18	7	95.5	9.1	2.9	0.3
Cariaco	242.2	178.0	28.4	26.9	20	9	103.1	10.9	2.6	0.1
Guaribero	214.0	166.6	26.1	24.1	16	6	94.3	11.3	2.3	0.1
Sabanero	195.0	155.8	28.0	25.7	16	4	85.5	10.2	2.5	1.7
Huevito	260.0	162.9	26.9	23.1	16	6	99.2	10.1	1.9	0.1
Puya	272.0	193.3	28.1	25.6	16	5	106.6	11.0	2.6	0.0
Tusón	232.5	211.3	28.0	24.9	17	6	101.5	10.8	2.4	0.1
Cuba Yellow Flint	300.0	222.6	32.4	29.7	16	5	113.8	11.8	2.6	0.0
Chandelle	291.7	228.5	29.3	26.8	19	7	110.5	11.6	2.5	0.4
Costeño	298.5	231.1	31.1	28.2	20	8	113.0	11.4	2.5	0.1
Puya Grande	307.0	234.1	31.0	28.1	17	5	114.8	12.0	2.5	0.2
Tuxpeño	331.0	212.5	31.5	28.4	16	5	115.4	11.6	2.7	0.2
Común					Data not available					
Negrito	282.0	227.5	30.3	27.7	18	6	107.5	11.3	2.6	0.0
Cacao	295.0	270.4	31.7	30.2	20	5	99.1	11.0	2.5	0.3

TABLE 3. Races of Maize of Venezuela Compared in Characters of the Tassels

	Length (cm.)		*Branching Space*		*Branches*		
Races	*Tassel*	*Peduncle*	*Length (cm.)*	*Per cent*	*No.*	*% Secondary*	*% Tertiary*
Chirimito	45.3	18.4	21.4	47.2	46.7	27.2	3.0
Aragüito	32.7	14.2	14.9	45.5	33.5	24.2	2.1
Pollo	37.8	21.9	12.7	33.2	19.3	22.8	4.1
Canilla Venezolano	38.4	19.1	19.7	51.3	33.9	22.7	3.8
Pira	35.4	21.1	18.8	53.1	36.2	24.0	1.4
Cariaco	37.6	17.5	19.1	50.8	37.0	20.5	3.5
Guaribero	38.2	16.9	18.8	49.1	43.6	28.9	4.5
Sabanero	41.9	16.8	21.1	50.5	36.2	28.7	6.9
Huevito	41.9	17.2	18.7	44.6	32.7	25.1	4.0
Puya	40.1	19.9	19.7	49.1	33.1	22.1	3.0
Tusón	30.6	19.8	19.4	63.3	34.6	23.7	1.2
Cuba Yellow Flint	43.6	21.3	18.9	43.3	31.7	18.9	1.9
Chandelle	41.7	19.8	20.4	48.9	34.2	23.4	1.8
Costeño	39.4	21.1	19.4	49.2	34.2	22.2	2.0
Puya Grande	41.7	20.5	20.8	49.8	30.2	18.5	1.7
Tuxpeño	41.8	19.8	21.6	51.6	34.3	23.3	1.7
Común	Data not available						
Negrito	41.5	20.0	19.1	46.0	36.1	23.0	4.2
Cacao	41.2	22.3	22.8	55.3	45.4	28.6	8.4

TABLE 4. Races of Maize of Venezuela Compared in External Characters of the Ears and Kernels

Races	*Length (cm.)*	*Diam. (cm.)*	*Row No.*	*Angle of Tapering Degrees*	*No. Husks*	*Characters of the Kernels* Length (mm.)	Width (mm.)	Thickness (mm.)	Hardness	*Denting*
Chirimito	9.3	29.5	13.1	6.30	20.2	8.7	6.7	3.6	1.2	5.0
Aragüito	9.2	31.2	13.2	5.85	15.8	8.9	9.7	3.7	2.2	4.9
Pollo	11.2	36.7	9.8	4.03	8.2	10.1	9.9	5.2	1.6	4.9
Canilla Venezolano	16.7	33.7	14.6	3.55	15.6	10.4	6.7	4.0	1.2	4.9
Pira	10.9	25.6	10.8	2.78	17.4	9.7	5.8	3.0	1.0	5.0
Cariaco	13.3	42.9	15.0	4.52	18.3	11.2	7.6	3.9	5.0	4.2
Guaribero	11.7	36.4	15.5	5.83	17.7	9.7	7.0	3.8	1.2	4.9
Sabanero	16.0	44.3	12.3	4.13	10.3	10.2	9.4	5.7	3.6	4.8
Huevito	15.6	38.1	10.5	3.01	9.3	10.2	9.8	4.9	1.4	4.9
Puya	17.1	38.3	13.6	2.57	15.8	11.5	7.1	3.4	2.3	2.2
Tusón	17.0	47.8	14.9	3.45	—	12.0	9.1	4.1	2.2	3.9
Cuba Yellow Flint	16.7	40.4	13.1	3.02	—	10.6	8.6	4.1	1.3	4.9
Chandelle	18.2	36.4	11.6	2.73	15.8	11.4	8.1	3.9	1.7	4.0
Costeño	16.0	45.4	13.7	4.12	16.0	11.2	9.0	4.1	1.6	4.4
Puya Grande	21.6	46.1	13.6	2.98	15.0	12.0	9.0	4.2	1.8	4.0
Tuxpeño	19.2	48.7	13.3	3.17	15.9	13.4	9.5	3.9	2.3	3.3
Común	18.4	41.0	11.7	2.98	—	11.7	9.3	4.1	1.8	4.4
Negrito	16.1	41.2	13.7	3.67	—	11.1	8.4	4.3	3.3	4.8
Cacao	15.0	45.6	12.6	4.87	12.9	11.5	10.1	5.3	2.0	4.8

TABLE 6. Races of Maize of Venezuela Compared in Physiological and Genetic Characters

Races	Adap. to altitude (meters)	Maturity	Rust	Helminthosporium	Pilosity	Colors in Plants and Ears				
						Plant score	Percentages of Ears with color in			
							Lemmas	Glumes	Aleurone	Pericarp
Chirimito	180	68	1.8	1.8	3.1	1.6	31.7	50.0	0.0	0.0
Aragüito	170	55	2.3	1.9	2.7	3.1	21.2	64.3	26.0	0.0
Pollo	1380	58	2.2	1.8	1.2	3.0	60.0	74.6	25.0	7.5
Canilla Venezolano	260	68	2.4	1.9	3.1	1.6	22.1	42.3	0.0	1.7
Pira	180	73	2.9	1.8	3.6	1.8	0.0	14.3	0.0	0.0
Cariaco	200	70	2.4	1.4	3.6	1.8	3.3	48.6	0.0	0.0
Guaribero	115	89	1.4	1.0	3.7	1.4	12.0	54.3	2.0	0.0
Sabanero	2430	194	4.0	2.2	2.7	2.8	44.0	52.5	20.0	60.0
Huevito	910	86	2.6	1.6	2.1	2.8	32.5	71.4	0.0	0.0
Puya	121	78	2.5	2.0	3.6	1.5	52.5	50.0	0.0	2.5
Tusón	450	61	1.8	1.4	3.0	1.4	32.5	32.1	0.0	2.5
Cuba Yellow Flint	180	69	1.3	1.1	3.0	2.0	30.0	64.3	0.0	0.0
Chandelle	305	71	1.9	1.2	3.4	1.8	33.3	69.0	0.0	33.3
Costeño	290	72	1.8	1.3	3.6	1.6	24.0	50.4	10.0	13.0
Puya Grande	247	72	1.7	1.0	3.5	1.3	27.5	60.3	0.0	0.0
Tuxpeño	330	70	1.5	1.6	3.5	2.0	100.0	66.7	0.0	0.0
Común	700			Data not available			20.0	85.7	0.0	1.2
Negrito	100	73	2.1	1.1	2.9	2.3	50.0	62.5	100.0	0.0
Cacao	220	83	3.1	2.2	3.0	1.8	18.4	69.7	55.5	15.6

TABLE 5. Races of Maize of Venezuela Compared in Internal Characters of the Ears

Races	Diameter (mm.)			Indices		Pubescence		
	Ear	Cob	Rachis	Cob/rachis	Glume/kernel	Cupule	Lower Glume	Upper Glume
Chirimito	29.5	15.9	11.6	1.37	0.24	3.0	2.0	1.0
Aragüito	31.2	15.3	11.1	1.38	0.23	2.7	1.8	0.6
Pollo	36.7	18.9	13.0	1.45	0.29	2.5	0.9	0.4
Canilla Venezolano	33.7	18.2	12.2	1.49	0.29	2.6	1.1	0.4
Pira	25.6	13.8	8.2	1.68	0.30	2.8	0.8	0.1
Cariaco	42.9	24.4	17.2	1.42	0.33	2.6	1.5	0.7
Guaribero	36.4	20.3	14.6	1.39	0.31	3.0	1.4	0.5
Sabanero	44.3	25.5	16.7	1.53	0.43	2.4	1.1	0.2
Huevito	38.1	21.7	14.4	1.51	0.36	2.6	1.1	0.3
Puya	38.3	19.4	13.6	1.42	0.25	2.7	1.4	0.6
Tusón	47.8	27.7	19.3	1.43	0.41	2.2	1.7	1.1
Cuba Yellow Flint	40.4	22.6	15.8	1.43	0.32	2.5	1.4	0.7
Chandelle	36.4	19.6	12.5	1.52	0.28	2.4	1.2	0.5
Costeño	45.4	26.2	18.8	1.39	0.33	2.5	1.2	0.6
Puya Grande	46.1	24.2	16.8	1.44	0.31	2.1	1.4	0.7
Tuxpeño	48.7	27.9	19.9	1.40	0.30	2.4	1.4	0.6
Común	41.0	22.4	15.7	1.42	0.28	2.6	1.1	0.2
Negrito	41.2	23.2	15.4	1.50	0.35	2.2	1.4	0.6
Cacao	45.6	28.1	18.2	1.54	0.43	2.0	1.0	0.0

TABLE 7. List of Collections Studied as Representative of Each Race of Venezuelan Maize

Race	*Accession Number of Collection*
Chirimito	Typical Collections: Ven. 703, 529. Others: Ven. 647, 577, 769, 586, 618, 883, 437.
Aragüito	Typical Collections: Ven. 678, 568, 760, 628, 694. Others: Ven. 813, 788, 719, 695, 657, 611, 745.
Pollo	Typical Collections: Ven. 383, 336, 310. Others: Ven. 308, 387, 381, 512, 328, 335, 554.
Canilla Venezolano	Typical Collections: Ven. 604, 576, 874, 475, 981, 693. Others: Ven. 316, 456, 746, 603, 559, 487, 689, 681, 490, 616, 671, 585, 566, 470, 513, 555, 595.
Pira	Typical Collections: Ven. 457, 485, 956. Others: Ven. 500, 739.
Cariaco	Typical Collections: White: Ven. 408, 341, 757, 631. Yellow: Ven. 639, 643. Others: White: Ven. 677, 497, 976, 356, 575, 427, 327, 789, 438, 541, 407, 641, 395, 543, 646, 510, 758, 508, 417, 661, 632, 610, 782, 656, 759, 926, 599, 560, 590, 612. Yellow: Ven. 971, 439.
Guaribero	Typical Collections: Ven. 572, 653, 733. Others: Ven. 629, 567, 602, 607, 573, 540, 394, 729, 690, 582, 665, 459, 662, 835, 550, 752, 751, 605, 583, 537, 524, 588, 551, 581, 744, 363, 530, 633, 700, 397, 753, 571, 377, 564, 589, 584, 644, 724, 329, 496, 748, 609, 600, 402, 563, 359.
Sabanero	Typical Collections: Ven. 736, 666, 514, 307. Others: Ven. 389, 558, 548, 311, 707, 519, 473, 382, 533, 464.
Huevito	Typical Collections: Ven. 369, 959, 396, 445. Others: Ven. 939, 547, 511, 937, 900, 469, 330, 539, 483, 955, 528, 940, 477, 952, 384, 552.
Puya	Typical Collections: Ven. 349, 946, 780. Others: Ven. 393, 353, 893, 945, 932, 934, 338, 553, 944, 332, 337, 347, 943, 350, 823, 933, 822, 652, 783, 808.
Tusón	Typical Collections: Ven. 442, 405, 699, 318. Others: Ven. 374, 556, 503, 358, 968, 684, 419, 676, 471, 851, 785, 468, 592, 321, 391, 709.
Cuba Yellow Flint	Typical Collections: Ven. 331, 664, 696, 650. Others: Ven. 743, 416, 852, 619, 734, 614, 873, 720, 862, 392, 532.
Chandelle	Typical Collections: White: Ven. 409, 489, 460, 352. Yellow: Ven. 717, 432. Others: White: Ven. 927, 452, 801, 390, 454, 323, 521, 965, 569, 334, 378, 401, 867, 517, 534, 806. Yellow: Ven. 344, 386, 887, 420, 324, 317, 899.
Costeño	Typical Collections: White: Ven. 832, 847, 415, 843, 453. Yellow: Ven. 775, 859, 958, 970, 954. Others: White: Ven. 863, 844, 418, 898, 854, 515, 682, 856, 833, 549, 444, 379, 871, 740, 498, 906, 838, 466, 860, 849, 953, 478, 861, 761, 936, 499, 436, 879, 842, 857, 518, 845, 884, 827, 855, 984, 885, 399, 654, 872, 778, 892, 342, 411, 894, 367, 837, 951. Yellow: Ven. 864, 836, 683, 949, 825, 706, 424, 574, 710, 961, 606, 722, 826, 704, 488, 502, 493, 431, 645, 679, 591, 975, 950, 669, 756, 846, 306, 565, 839, 400, 375, 777.

TABLE 7. List of Collections Studied as Representative of Each Race of Venezuelan Maize—Continued

Race	*Accession Number of Collection*
Puya Grande	Typical Collections: White: Ven. 587, 495, 345.
	Yellow: Ven. 481, 312, 355, 651.
	Others: White: Ven. 814, 435, 354, 357, 625, 750, 440, 480, 542, 451, 474, 800, 621, 325, 655, 667, 597, 810, 626, 820, 373, 715, 484, 314, 472, 675, 742, 482, 410, 617, 544.
	Yellow: Ven. 705, 596, 741, 546, 762, 421, 642, 491, 648, 962, 370, 398, 721, 747, 465, 506, 698, 578, 531, 505, 685, 663, 735, 443, 980, 660, 766.
Tuxpeño	Typical Collections: Ven. 598, 891, 692, 414.
	Others: Ven. 815, 441, 538, 896, 901, 790, 910, 768, 716, 413, 343, 983, 982, 708.
Tuxpeño sub-race "Pailón"	Typical Collections: Ven. 309, 767.
	Others: Ven. 686, 634, 974, 714, 817, 425, 907, 422, 613, 723, 319, 728, 713, 764, 977, 973, 494, 732, 361, 966, 406, 623, 725, 668, 726, 674, 712, 749, 737, 376, 754, 701, 738, 659.
Común	Typical Collections: White: Ven. 340, 897.
	Yellow: Ven. 448, 881.
	Others: White: Ven. 929, 868, 711, 875, 886, 834, 923, 935, 830, 428.
	Yellow: Ven. 366, 557, 779, 876.
Negrito	Typical Collections: Ven. 673, 426, 870.
	Others: Ven. 371, 680, 809, 920.
Cacao	Typical Collections: Ven. 630.

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