RACES OF MAIZE IN THE WEST INDIES

William L. Brown

NATIONAL ACADEMY OF SCIENCES—
NATIONAL RESEARCH COUNCIL

Publication 792

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COMMITTEE ON PRESERVATION OF INDIGENOUS STRAINS OF MAIZE

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RACES OF MAIZE IN THE WEST INDIES

William L. Brown[1]

INTRODUCTION

A preliminary account of West Indian maize was published by the author in 1953 (5). This included a tentative classification and descriptions of the readily recognizable racial entities of this relatively small but important segment of Western Hemisphere maize. Since 1953 considerable advance has been made in our understanding of the races, their distribution and relationships of much of the maize of Central and South America (3, 19, 20, 24, 25). As there are obvious relationships between the maize of the Caribbean Islands and the adjacent Middle and South American mainland, it now seems desirable to reconsider West Indian maize in light of these relationships. Secondly, as a result of additional studies on West Indian maize itself, new facts bearing on the problem of classification of this group of corns have been discovered. Although these include some additional studies by the author, the intensive analysis of Cuban maize reported by Hatheway (13) contains the bulk of new information on West Indian maize brought to light since 1953. Also since the Caribbean comprises one of the areas which the Committee on the Preservation of Indigenous Strains of Maize of the National Academy of Sciences—National Research Council included in its original scheme for collecting and studying Western Hemisphere maize, a treatment of West Indian maize following, more or less, the pattern established by the Maize Committee in its earlier publications seems desirable.

Compared to that found in Mexico, Central and South America the amount of variability among maize of the West Indies is comparatively slight. Some maize is grown on most of the islands, yet the number of distinct races present are comparatively few. Nonetheless the maize of this area is important for several reasons. It is widely distributed in both hemispheres, having been intro-

[1] Geneticist, Department of Plant Breeding, Pioneer Hi-Bred Corn Company and Committee member.

duced into Europe by the early explorers and having spread from there to the Pacific and elsewhere. Because of its wide adaptability and exceptional vigor it has proven to be a highly effective source of germ plasm for improving the maize of lowland tropical America, a good part of the Orient, southern Europe as well as the southern part of the United States. A more detailed discussion of the practical usefulness of West Indian maize will be presented in a subsequent section. Suffice it to say here that this is probably one of the world's most important sources of maize breeding materials.

The problem of classification of West Indian maize is a particularly difficult one, not because of the number of races found in the area but due to the absence of barriers to hybridization and the resulting mongrelization of races. The area was inhabited by at least two cultures of agricultural peoples in pre-Columbian times, the Arawak and the Caribs, each of whom depended in part at least on maize as a source of food. The aboriginal inhabitants apparently moved freely between the various islands and thus evidently, at an early date, initiated the mixing of varieties, a practice which has proceeded to the present time. In post-Columbian times the area has been inhabited by Spaniards, English Colonials, Orientals, African negroes as well as various peoples from both North and South America. Most of these immigrants have had some influence upon the agricultural history of the area. There has been free migration not only between islands but between the islands and the mainland. Such movement is clearly reflected in the present day maize of the islands where some of the varieties are almost identical with certain of the races of maize of Central and South America. Thus it is clear that as a result of the various cultural and geographic factors tending to encourage interracial hybridization, there has been a significant masking of racial differences which might have been transparent in pre-Columbian or early post-Columbian times. The problem of classification, although made more difficult with the passing of time is not impossible. As will be shown later the essential features of a number of races of maize have been preserved and are recognizable even today.

Previous surveys of maize of various parts of the Western

Hemisphere have had as one objective a better understanding of the possible origin and subsequent evolution of the genus *Zea*. Studies conducted in both Middle and South America, for example, have revealed the existence of primitive races, have in some cases demonstrated a relationship between these and even more primitive archaeological types and, using the tools of modern genetics, have attempted to trace the evolutionary steps culminating in numerous modern races, varieties and Mendelian populations. Because of the very nature of the area and the material, information of this kind cannot be expected to result from a study of West Indian maize. The area is a melting pot not only of peoples but of their cultivated plants as well. If primitive races ever existed in the West Indies most have long since been drastically altered through hybridization. Furthermore, the scarcity of prehistoric maize remaining in the area prevents the comparison of modern races with those that might have been present in prehistoric times.

AREA INCLUDED IN THE STUDY

Collections on which the present study is based come from an area extending roughly 2,000 miles in a northwesterly-southeasterly arc, bounded by Cuba on the northwest and Trinidad on the southeast. Thus the entire range of the West Indian islands is represented in the collections. The islands which were either visited by the author or from which collections were made by other individuals include Cuba, Jamaica, Haiti, Dominican Republic, Puerto Rico, Saint Croix, Saint Kitts, Antigua, Dominica, Martinique and Trinidad (Fig. 1). No attempt was made to obtain samples from all of the islands, instead efforts were concentrated either on the larger islands or those on which maize is of considerable economic importance as a crop.

Although maize is still grown rather extensively in Puerto Rico, it is not included in the present study. The author visited Puerto Rico and concluded on the basis of observations there that most maize of the island consists either of recent introductions or of mixtures of recent introductions with indigenous varieties. It was felt, therefore, that the inclusion of Puerto Rican material in the present study would tend to confuse rather than clarify our understanding of indigenous West Indian maize. It is unfortunate that Puerto Rican maize was not collected prior to its contamination from outside sources since according to Rouse (22) Puerto Rico represents the center of the Taino tradition, the most advanced of Arawak culture types.

Although maize of Dominica and St. Kitts was not collected by the author, collections from these islands were made by their respective Departments of Agriculture and are included in the study.

No attempt has been made in this study to include collections of Caribbean type maize from the South and Central American mainland. Races very similar to certain of those described for the West Indies are widely distributed throughout the coastal areas of eastern South America. For the most part, however, these have been included in previously published race studies or are being treated in studies currently in progress. The author has had opportunity to examine in considerable detail many of the collections of South and Middle American maize and any obvious

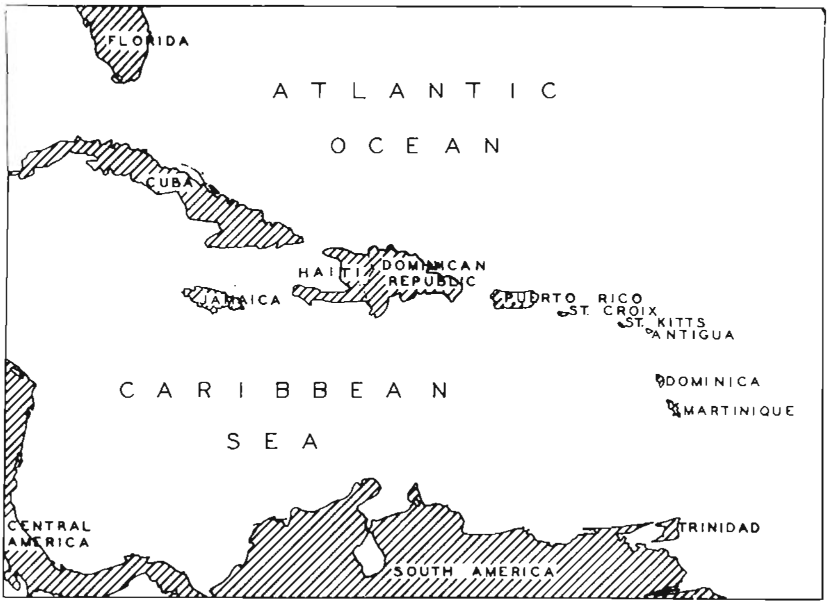


FIG. 1. Map of a portion of the West Indies showing those islands where maize was collected.

relationships between these and recognized West Indian races will be discussed in subsequent sections.

ABORIGINAL CULTURAL GROUPS

The West Indies were apparently inhabited by three groups of aborigines at the time of historic contact (21). These were the *Ciboney*, *Arawak* and *Caribs* who, according to Rouse (21), appeared in the islands in that order. At the time of the Discovery the Ciboney were occupying a limited area at the eastern end of Cuba. The Arawak were spread over a large part of the West Indies including the Bahamas, central and western Cuba, Jamaica, Hispanola and Puerto Rico as well as a part of Trinidad. The Carib occupied most of the Lesser Antilles and the major part of Trinidad.

The Ciboney are thought to have been a non-agricultural culture of cave dwelling hunters and fishers. They are assumed by most archaeologists to have reached the West Indies from Florida. It is felt their distribution in prehistoric time was greater than that at the time of the Discovery and that their historic position resulted from pressure from the more advanced Arawak and Carib (21). Ciboney archaeological sites have seemingly added little to our knowledge of the culture of these peoples. Rouse (21) states, "Pottery is never present, nor are the griddles on which the Arawak used to bake cassava. Except in a few sites, which seem to have been under Arawak influence, no traces have been found in the Ciboney sites of the elaborate ceremonial apparatus of the Arawak, such as bone spatulas for inducing vomiting, shell marks and representatives in stone, bone and shell of the anthropomorphic deities which the Arawak called *zemis*." Many of the Ciboney archeological sites also lack traces of fire from which it is deduced that much of the food used by the Ciboney may not have been cooked. Since the Ciboney were non-agricultural they, of course, have had no influence on the evolution of maize of the area they occupied.

The Arawak, in contrast to the more primitive Ciboney, possessed a well developed agriculture which included the use of fertilizer and irrigation. Although manioc was probably their chief source of carbohydrate, they also made extensive use of maize. Rouse (22) describes their maize culture and uses as follows: "It (maize) was always planted on the hillsides and without the benefit of mounds heaped up for the planting of cassava. The ash from the burned forest was used as fertilizer, and the planting took place twice a year, during the new moon and after it had commenced to rain. Each planter carried the kernels in a bag around her neck. She dibbled four or five kernels in each hole, a pace apart, working the planting stick with a vertical motion. Birds were kept from the fields by the children, stationed on platforms in the trees."

"From the absence of metates in prehistoric times, it has been assumed that the *Taino* (Arawak) then had only a soft variety of corn.[1] They harvested it green and used it mainly in a soup. After the Conquest, at least, they made cakes which were of two kinds, one for the commoners and the other for the chiefs. To produce the cake of the common people the women wet the grain and left it overnight. Then they ground it between two stones or possibly in wooden mortars hollowed out of tree trunks, mixed it with water to form loaves, wrapped the loaves in leaves which had previously been moistened, and baked them in the fire. . . . ."

"Corn meal was also used (after the Conquest at least) in the preparation of beer. The women put meal into large jars of water containing kernels of corn that had been warmed and chewed. They left this liquor to ferment, heated it for three or four hours, allowed it to cool, and then strained it through a cloth."

The Arawak are believed to have reached the West Indies from South America since their language is Amazonian and since their cultural affinities are with the South American mainland. Additional support for this hypothesis is found in the similarity between certain West Indian maize types (*Maiz Chandelle, Tusón, Coastal Tropical Flint*) and others in South America. The Arawak presumably entered the West Indies by way of Trinidad and the Lesser Antilles in Rouse's Period II. From there they spread northward and westward to Puerto Rico and possibly the Domini-

[1] As was indicated earlier by the author (5), the absence of metates does not necessarily mean that soft corn only was used. Flinty varieties could have been made edible by parching or popping and without grinding. As a matter of fact popping, along with brewing, was probably among the earliest uses made of maize.

can Republic. Period III is characterized by a division of the Igneri into two subgroups, the Taino and Sub-Taino (22). The former occupied the Virgin Islands, Puerto Rico and the Dominican Republic and the latter Haiti, Jamaica, Cuba and the Bahamas. It is presumed this increased development and spread of the Arawak was accomplished at the expense of the more primitive Ciboney.

It was the Arawak with whom Columbus first made contact in the Bahamas during his first voyage to the New World in 1492. It was also undoubtedly Arawak maize which Columbus saw for the first time in the West Indies and to which he made brief reference in his journal.

The Caribs, the third group of Indians to inhabit the West Indies, were also of South American origin. They are thought to have reached the West Indies not more than a century prior to the Discovery but by this time they had conquered all of the Lesser Antilles as well as a part of Trinidad (23). The Caribs were aggressive, warlike and cannibalistic and according to tradition spent much of their time in raiding the Arawak. As their villages were moved frequently it is unlikely that their agriculture was as highly developed as was that of the Arawak. They did use maize, however, cultivating it in much the same manner as did the Arawak and using it for the making of bread and beer. Little is known of the kinds of maize used by the Caribs, yet it is interesting to note that in the island of Dominica, the last West Indian stronghold of these peoples, *Coastal Tropical Flint* is still the dominant race of maize. This race is widely distributed throughout eastern South America and undoubtedly reached the West Indies from the South American mainland. The temperament of the Carib was such that it is difficult to imagine their having contributed much to agriculture or to the improvement of maize in the West Indies. According to tradition they were much more concerned with subduing their neighbors than with a settled agricultural existence. An example of the extreme practices they resorted to in preparing their youth for the rigors of adulthood are vividly described by Rouse (23), who states, "The youths were taught to value courage and endurance and were periodically rubbed with the fat of slaughered *Arawak* to make them brave. When they had reached the age of becoming warriors they were tested in these qualities. The youth having been seated on a stool in the center of the carbet, his father crushed a bird over his head, scarified his body, and rubbed the cuts with pepper sauce. Then the boy ate the heart of the bird, to give himself courage, and his father beat him. He had to endure this entire ceremony without flinching. . . ."

The history of the Indians following the Spanish Conquest is well documented (17, 18) and need not be repeated here. Following the establishment of permanent European settlements the Indians were soon reduced to a mere remnant of their former number. Their final decimation was assured through the system of "repartimientos" which was not abolished until 1550.

PREVIOUS STUDIES OF WEST INDIAN MAIZE

Prior to 1949 West Indian maize had received little attention from maize specialists. Brief reference was made to Cuban maize by Kuleshov (16) who stated that it was less variable than that from South America and consisted of *indurata* (flint) types. Del Valle (8, 9), whose primary interest was in maize improvement, described two types occurring in Cuba and gave them the names "Gabara" and "Francisco". In 1945, Hernández (14) brought together a collection of maize from Cuba for the Rockefeller Foundation—Mexican Government agricultural program in Mexico and from this collection described six provisional races. Apparently the results of Hernández' studies were not published but did undergo limited distribution in mimeographed form. Brown (5) in 1952 collected maize from eleven islands of the West Indies (Fig. 2). These were grown and studied the following year and as a result of these studies, Brown recognized eight more or less distinct races occupying the area at the time of his studies. He excluded from his classification two Cuban popcorns on the theory that they were probably relatively recent introductions from the United States. This theory was later confirmed by Hatheway (13) who actually traced the introduction of the two varieties to a particular United States seed company. Hatheway (13), in 1957, reported the results of a very detailed study of Cuban maize in which he described seven races. In addition to races that had been recognized by earlier authors, Hatheway described the two popcorns referred to above and a white dent which he thought to be allied to the race *Zapalote Chico* of western Mexico. The race in question was found in possession of one grower only, in Oriente Province of eastern Cuba. The extremely limited distribution of the variety certainly suggests it likely to be a recent introduction. Its presence is nonetheless intriguing since, were it not a recent introduction, it might explain the origin of denting in West Indian maize, the genes for which are scattered all the way from Cuba to Trinidad. In any case it would seem that a more intense search in eastern Cuba for Hatheway's white dent would be justified. The sources of denting germ plasm in West Indian maize are as yet poorly understood and any precise answer to this question would likely clarify considerably our understanding of the evolution of these corns as well as our understanding of the human cultures involved in their evolution.

Though not directly related to classification, Hatheway presents some interesting observations on Cuban farming practices, how corn is grown and the reasons for preference among Cuban

FIG. 2. A method of maize storage frequently encountered in Haiti. A large bundle of unhusked ears are attached to a woody liana and suspended from the limb of a tree. The top of the bundle is usually covered with banana leaves to provide protection from the elements.

farmers for particular varieties. This section of Hatheway's paper is highly recommended to those readers who have any interest in maize culture in Cuba. More recent influence of government on agriculture in Cuba renders even more important Hatheway's description of a system of farming which now seems fast disappearing.

COLLECTING PROCEDURES

Most of the collections which form the basis for this study were made by the author in 1952 either from farmer's fields or from granaries. When collecting from fields or from stored ear corn a conscious effort was made to select samples at random. The sample size varied from 5 to 15 ears. From each of the collections pertinent notes were taken on ear and kernel characteristics and the samples were then forwarded to the National Research Council—Rockefeller Foundation germ plasm bank at Chapingo, Mexico for permanent storage and seed increase.

Throughout the West Indies, maize is a prominent item of trade in most of the city and village markets. These market samples provide the collector with a tempting source of easily acquired collections as is evidenced by leafing through any plant introduction catalog. Maize collections acquired in this way, however, seldom provide an adequate representation of the maize of the area. For this reason such samples were avoided in this study.

The material from Dominica and St. Kitts were kindly provided by representatives of the departments of agriculture of these localities and were reported to be typical of the corn of the area. The unusually large collection from the Dominican Republic came from samples exhibited at an agricultural fair in that country and represented maize types from 250 growers from all parts of the Republic. These were made available to the author through the kindness of Mr. W. G. Bradley and the Institute of Inter-American Affairs.

At the time collections were being made the author encountered from time to time what were either recognized or reported to be recently introduced varieties from the U.S.A. or Mexico. No attempts were made to include such varieties in the collections since it was felt their inclusion would add nothing to the study of indigenous West Indian varieties.

CHARACTERS USED IN CLASSIFICATION

Characters of the Plant

Plant Height—This character was obtained from one average plant of a typical collection. The measurement was made from ground level to the tip of the central spike of the tassel.

Internode Pattern—After the modal number of internodes for each race had been determined, measurements from plants possessing the modal number were averaged and expressed in a diagram (Figs. 5, 8, 11, 14, 17, 20, 23). The resulting diagrams show for each race the pattern of relative internode lengths as well as the position of the ears. Numbers on the vertical scale of the diagrams represent lengths of internodes in centimeters. Numbers on the horizontal scale represent successive internodes from base to tassel.

Husk Leaf Blades—Modal length of husk leaf blades in centimeters.

Days to Anthesis—Number of days from planting to pollen shedding. The pollen shedding date is that on which approximately 50% of the plants of typical collections of the race were shedding.

Characters of the Tassel

Number of Primary Tassel Branches—Number of branches of the first order.

Number of Secondary Tassel Branches—Number of branches of the second order.

Number of Tertiary Tassel Branches—Number of branches of the third order.

Length of the Central Spike—Distance between the uppermost primary branch and the apex of the tassel.

Culm Diameter—Diameter in millimeters of the peduncle measured immediately below the lowest primary branch.

Tassel Exsertion—Distance between the lowermost primary branch of the tassel and the upper end of the sheath of the top leaf. This can be either a plus or minus value, depending upon whether the tassel is inserted or exserted.

Angle of Branching—Scored in three grades, as follows: 1. Primary branches drooping. 2. Primary branches at approximately right angles to the main axis. 3. Primary branches upright.

Condensation—Spikelet condensation was determined according to the technique described by Anderson (1). The index is computed by dividing the number of pairs of spikelets by the number of apparent nodes included in the middle three-quarters of the lowermost primary branch of the tassel.

Characters of the Ear

Basal Diameter—Diameter of the ear measured at a point three-quarters of an inch from the basal end.

Mid-ear Diameter—Diameter of the ear measured at the mid-point of its length.

Shank Diameter—Average diameter of the peduncle measured at the juncture of the ear and the peduncle. For somewhat elliptical peduncles an average was taken of the maximum and minimum diameters.

Kernel Width—Average width of ten kernels taken from near the mid-point of the ear.

Kernel Thickness—The thickness of ten consecutive kernels in a row near the mid-point of the ear. The measurements were made while the kernels were on the ear.

Kernel Length—An average derived from the measurement of ten kernels taken from near the mid-point of the ear.

Row Number—Number of rows of grains.

Denting—Denting was scored in five grades, as follows: 0—no soft starch at the apex of the kernel; 1—soft starch but no denting; 2—soft starch and a small dent; 3—soft starch and a deep dent but no wrinkling of the pericarp; 4—soft starch, deep dent and wrinkled pericarp.

Pointing—Scored in three grades, as follows: 1—no pointing; 2—intermediate; 3—extreme pointing.

METHODS OF STUDY AND CLASSIFICATION

In the study of a naturally cross pollinated species possessing the amount of genetic diversity of maize there inevitably arises the question as to what is acceptable as a racial concept. In this study the term "race" is employed in its broadest sense and has essentially the same meaning as that set forth by Anderson and Cutler (2), who state, "a race is a group of individuals with enough characteristics in common to permit their recognition as a group." As has been suggested by Hatheway (13) any useful racial concept should permit distinguishing between true interbreeding populations, "mongrels", and segregating types. Hatheway also feels that a race should be recognized as a distinct entity by the farmers who grow it. My own experience leads me to believe that this latter requirement could not be met in many instances. While it is true that many growers do recognize racial entities, many others do not. Farmers also frequently place considerable emphasis on color differences of both plant and kernel in distinguishing varieties. Since these are differences which are simply inherited in contrast to most characters of true diagnostic value, one needs to view critically many racial entities recognized as such by growers.

Data on ear and kernel characteristics were taken at the time the West Indian collections were made or received. The classification into races, however, is based primarily on a study of the progeny of the original collections. Approximately 50 plants from each of the 135 cultures were grown at the Imperial College of Tropical Agriculture at St. Augustine, Trinidad. Each of the collections were well adapted to Trinidad and favorable weather conditions prevailing during growth resulted in excellent specimens for study. In subsequent years, samples of each of the recognized races have been grown in the United States with varying degrees of success. These latter plantings have provided sporocytes for chromosome knob studies and some information on the amount of segregation within races but the reaction of the plants to changed photoperiod has precluded their being studied critically in the central United States. Plantings from the original collections were grouped by country from which they came and arranged within geographical groups according to a tentative classification made on the original ears. This permitted observation of the degree of uniformity within tentative racial groups and, what is more important, it made possible a comparison of plant characteristics with previously noted ear characteristics. At least twenty plants of each collection were used for measuring or scoring the various plant characteristics listed in Tables 9-15.

At harvest all normally developed ears were collected, dried and arranged on long benches in the order in which they had been planted. From a study of the assembled ears and previously recorded plant data, it soon became apparent that despite the heterogeneous nature of the material certain distinct morphological types tended to reoccur throughout the collections. It seemed apparent that some of the tentative races recognized at the time collections were made were valid, natural groups while some others were not. Eight such groups (races) were recognized and described (5). Additional subsequent study, however, has led to the belief that two of the originally described races (*West Indian Semi Dent* and *Cylindrical Dent*) should be combined since the variation in characters originally thought to separate the two races seems, as a result of further study, to be continuous.

Though an appreciable number of the ears studied could not be assigned to any one of the recognized races, this number represented a small part of the entire collection.

Twenty-five-ear samples of each of the races have been used as a source of ear data presented in Tables 2-8. These ears were taken at random from a larger group classified as typical of each race.

An effort has been made to use for classification purposes only those characteristics which as a result of past experience, are felt to have real value in delimiting natural entities. For this purpose much more emphasis has been given to characters of the ear and tassel than of the plant. The use of characters whose expression is known to be governed by one or two gene pairs has been avoided regardless of how conspicuous these characters may be. Typical examples of such characters are those affecting the color of the plant, endosperm and pericarp. Of a much more critical nature are differences in shape of the ear, number of rows of kernels, length, width and thickness of the kernel, texture of the endosperm and various characters which determine the gross morphology of the tassel. It is characters of this nature that have been used primarily in delimiting the races described in the section immediately following.

INDIGENOUS RACES—DESCRIPTIONS AND DISTRIBUTIONS

In the pages that follow seven races of West Indian maize are described. These do not include a few previously described races which have been recently introduced into the islands and which will be referred to briefly in a subsequent section. It is believed the classification represents a relatively natural one, yet it should be emphasized that this treatment is in no way felt to be a final answer to the race problem in West Indian maize. The present treatment, however, will at least provide a starting point for future students who may be interested in attempting to work out in more detail the true relationships of these highly evolved corns.

The method by which race descriptions are presented here differs somewhat from that used in the earliest publications of this series (24, 25) and tends to follow the method used in the study of Bolivian maize (19). Detailed data relating to particular characteristics of the plants are given in tabular form only (in the appendix). These are supplemented by descriptive accounts of the characteristic morphological features of various plant parts, photographs of typical ears and plants and typical internode diagrams of each race.

Finally, it will be noted that the origins of the races described herein are treated only tentatively. 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. On the other hand, recent collections of maize from lowland South America, which were not available at the time of earlier studies of West Indian maize, reveal the presence of certain varieties which appear to be very similar to those from the West Indies. These, for the most part, come from Colombia, Venezuela and Argentina and the apparent relationships between these and West Indian races will be recognized in this report.

CUBAN FLINT

Ear photograph, Figure 3
Plant photograph, Figure 4
Internode diagram, Figure 5
Tables 2 and 9

Ears short, slightly compressed at base and gently tapered toward the tip. Numbers of rows of kernels vary from 12 to 16 with a modal number of 14. Kernel rows quite straight. Kernels short, ranging from flat topped to slightly pointed. Aleurone and pericarp colorless. Endosperm flinty, deep orange yellow in color. Cobs white. Glumes of the pistillate spikelet short and of medium texture. Shanks are short and of relatively narrow diameter (approx. 16.5 mm).

Tassels are well exserted. Primary branches number approximately twenty and are conspicuously short in comparison with other West Indian races. Staminate glumes short and broad. Pedicels of pedicellate spikelets short.

The most conspicuous vegetative feature of *Cuban Flint* is its strongly pubescent leaf sheaths, a characteristic encountered only infrequently in other West Indian races. Plants are relatively tall, averaging 235 cm., are without tillers or conspicuous husk leaf blades. Leaf sheaths are frequently larger than their enclosed culm. Anthocyanin color is absent or nearly so. Husks are very tight and extend well beyond the tips of the ears. Two well developed ears per plant are not uncommon.

Plants of *Cuban Flint* reach anthesis approximately 60 days after planting.[1]

This race is the only true flint found in the West Indies. Its distribution is limited to Cuba where it is found most frequently in the eastern part of the island (Oriente Province). Among the more frequently encountered local names for the race are "Argentino" and "Francisco". It is preferred to other varieties as a source of corn meal and is also preferred by some growers because of the resistance of its hard, flinty kernels to attack from grain weevil. According to Hatheway (13), grain dealers pay as much as 25% more for *Cuban Flint* than for grain of softer varieties.

Brown (5) pointed out that *Cuban Flint* was very similar in

[1] Days from planting to flowering are based on data collected in Trinidad, B.W.I.

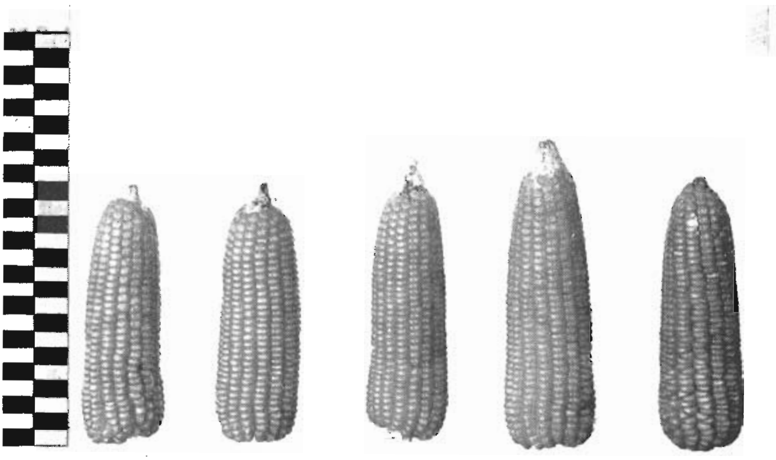


Fig. 3. Typical Ears of Cuban Flint.
(Centimeter scale used on all ear photographs.)

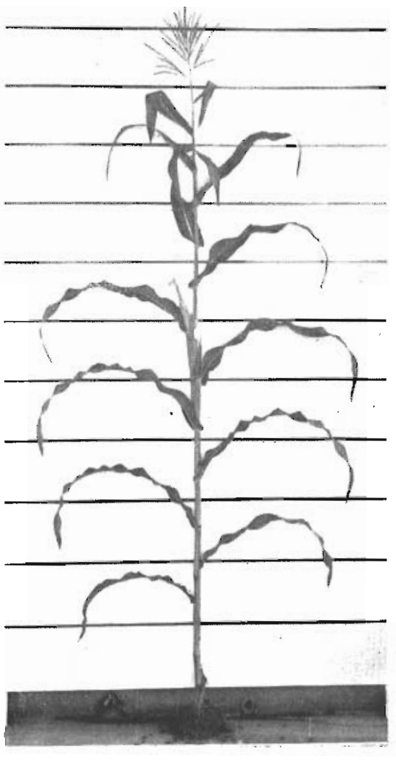


Fig. 4. Typical Plant of Cuban Flint.
(Each division on background of plant photographs = 25 cm.)

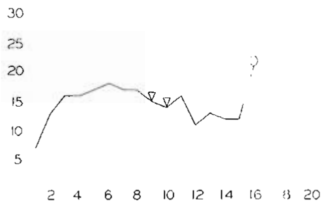


Fig. 5. Internode Diagram of Cuban Flint.

most of its characteristics to certain of the more common corns of Argentina and suggested it probably reached Cuba only rather recently from that country. Hatheway (13) came to the same conclusion and documented the importation of Argentine maize into Cuba with figures obtained through the Cuban Ministero de Hacienda. This agency reported that between 1914 and 1930 more than 171,000 tons of maize were imported into Cuba from Argentina. Cuban importers also informed Hatheway that the type of maize obtained from the Argentine was an orange flint. Thus it seems clear that *Cuban Flint* is a relatively recent introduction. Some question remains, however, as to how extensively the race has been altered since its arrival in Cuba. Hatheway (13) suggests that the race, as it is now known in Cuba, may be the result of accidental crossing of Argentine flint with local (Criollo) Cuban varieties. He reasons that Argentine flints are poorly adapted to Cuban conditions and that *Cuban Flint,* although similar in ear type to Argentine flint, resembles Cuban varieties in plant type. It is reasonable to suppose that some introgression between Argentine and Cuban varieties has occurred yet my observations of the material on which the above description is based lead me to believe that little germ plasm of Cuban varieties has been added to the Argentine flint since its introduction. In contrast to Hatheway's statement, the plants of *Cuban Flint* with which I have worked are quite different from those of other Cuban races. Two of the most conspicuous characteristics of *Cuban Flint* are the short primary tassel branches and the pubescent leaf sheaths. Neither of these characteristics are typical of other Cuban races.

Relationship to Previously Described Races

Cuban Flint is one and the same race as that previously described by Brown (5) under the same name. As mentioned above, it is also similar to, if not identical, with "Argentino" described by Hatheway (13) and Race 5 of Hernández (14). *Cuban Flint* appears also to be similar to certain collections from Chile, particularly Chile 404. Certain of the "Catetos" described by Brieger, et al (3) are obviously similar to *Cuban Flint* and probably represent the source of this race.

HAITIAN YELLOW

Ear photograph, Figure 6
Plant photograph, Figure 7
Internode diagram, Figure 8
Tables 3 and 10

Ears approximately 18 centimeters in length, pyramidal with conspicuously enlarged bases and strong taper toward the tip. Row numbers range from 8 to 14 with a mean number of about 11. The kernels are strongly pointed and usually possess a slight capping of soft starch. Some kernels are very slightly dented. Endosperm predominately yellow, rarely white. Aleurone colorless. Pericarp colorless or infrequently red or bronze. Shanks are hard and brittle with many condensed internodes. Pistillate glumes strongly indurated.

Tassels inserted to exserted with twenty or more relatively short, upright branches.

Plants are of late maturity and strikingly vigorous. Ears are placed high on the plant and are enclosed in hard, stiff husks. Culms and leaf sheaths exhibit deep purple anthocyanin color. Husk leaf blades are much more extensively developed than in other West Indian races. Tillers are absent or nearly so. Leaves are proportionately wide for their length.

The distribution of *Haitian Yellow* is apparently limited to Haiti and is there concentrated in the region of Marfranc and Moron. Nothing closely approaching it in type has appeared in collections from other parts of the West Indies, including neighboring Dominican Republic. This very limited distribution is rather puzzling since the race seems not to be a recent introduction nor is it used for any special purposes by the people who grow it.

Relationship to Previously Described Races

Haitian Yellow, first described by Brown (5), is somewhat similar in ear characteristics to "Guatemalan Tropical Flint" described by Anderson and Cutler (2). It also resembles some of the subraces of "Serrano" from Central America (25). It is not unlikely, however, that these resemblances are strictly superficial since both Central American corns are from high altitudes

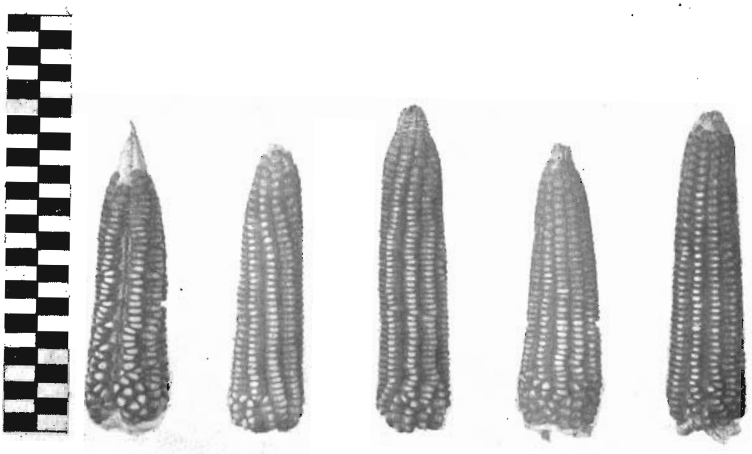
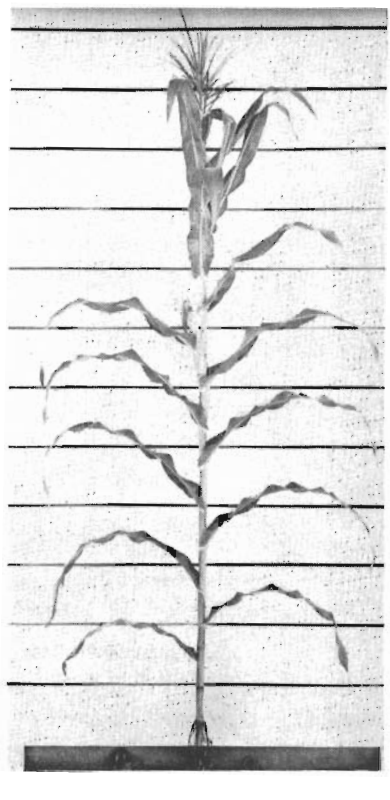


FIG. 6. Typical Ears of Haitian Yellow.



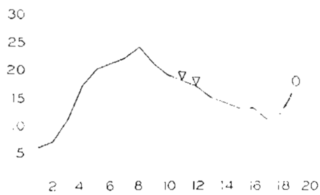


FIG. 8. Internode Diagram of Haitian Yellow.

FIG. 7. Typical Plant of Haitian Yellow.

and would likely be very poorly adapted to the environment of Haiti. This race is not duplicated in the South American collections examined by the author and if the resemblance to the two Central American races mentioned above is superficial it then seems reasonable to assume that *Haitian Yellow* is probably of hybrid origin, having arisen in Haiti. Its limited distribution would suggest further that it is probably of relatively recent origin.

COASTAL TROPICAL FLINT

Ear photograph, Figure 9
Plant photograph, Figure 10
Internode diagram, Figure 11
Tables 4 and 11

Ears 18-24 centimeters in length and slightly tapered. Numbers of kernel rows vary from 8 to 14 with a modal number of 12. Grains only slightly longer than wide and usually possessing a slight capping of soft starch. Colorless aleurone and usually colorless pericarp. Endosperm deep yellow but lacking the orange pigment characteristic of *Cuban Flint*. Pistillate glumes are of soft texture.

Tassels well exserted and extensively branched (average of 26 primary branches and 10 secondaries). Primary branches heavy and more or less drooping. Occasional plants exhibit considerable condensation of tassel branch internodes. These, however, are exceptional rather than usual.

Plants are of medium maturity (68 days to anthesis). When grown in the tropics the plants are tall and without tillers. Leaves are long and proportionately narrow. Leaf sheaths are nearly always glabrous. Plants occasionally produce more than one ear which is placed high on the plant and is always without flag leaves. Dilute sun red plant color occurs frequently.

Coastal Tropical Flint is apparently the same race as that described by Cutler (7) and which he found to be widely distributed along the east coast of South America. As a means of eliminating confusion the race name used by Cutler is being retained here. *Coastal Tropical Flint* is widely distributed in the West Indies as well as in eastern South America. It is also found in the Pacific Islands and was one of the more prevalent varieties of maize of southeastern United States prior to the introduction of hybrid corn into that area. It seems logical to assume that this race was introduced into Europe soon after the Discovery (11). The more typical and less contaminated representatives of *Coastal Tropical Flint* are today found on the island of Dominica, one of the last strongholds of the Carib Indians.

Coastal Tropical Flint probably reached the West Indies from the lowlands of eastern South America. Its extensive distribution

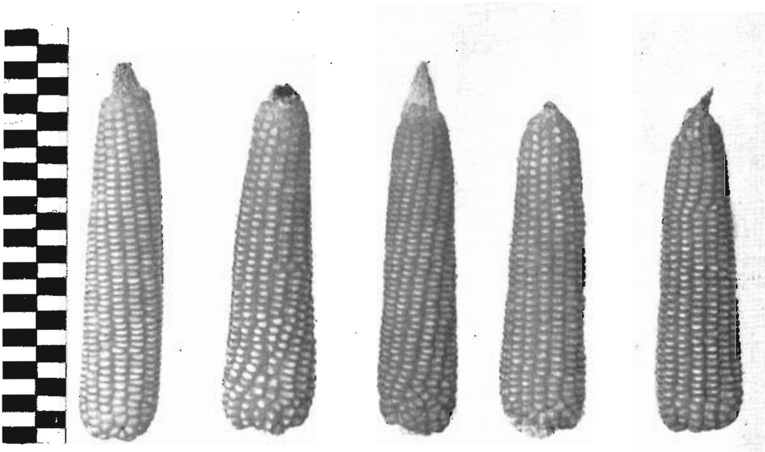


FIG. 9. Typical Ears of Coastal Tropical Flint.

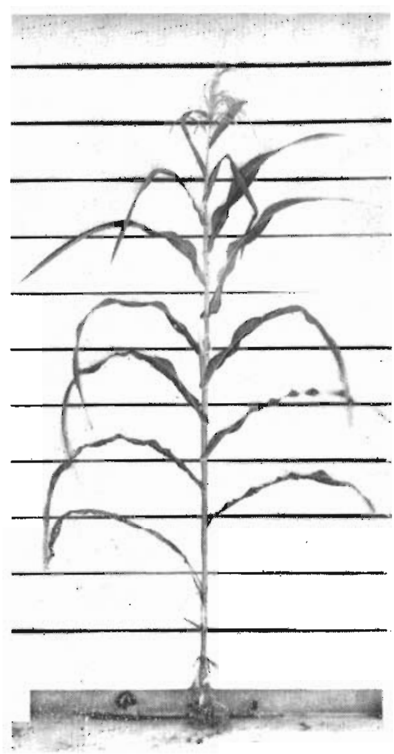


FIG. 10. Typical Plant of Coastal Tropical Flint.

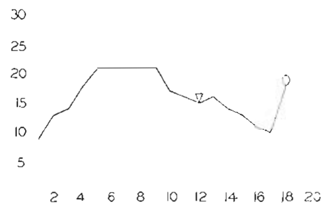


FIG. 11. Internode Diagram of Coastal Tropical Flint.

in the islands today and historical evidence indicating it to be one of the first types of maize introduced into Europe suggest that it was in the West Indies at the time of historic contact. Hatheway (13) is of the opinion that *Coastal Tropical Flint* may have polyphyletic origins; one in eastern South America and another in Cuba. This is based on the occurrence in Cuba of strains of *Coastal Tropical Flint* which, in many morphological characters, are intermediate between *Cuban Flint* and a semi-dent maize which is widespread throughout the West Indies, including Cuba. That such might be true seems likely but such an origin in the West Indies would necessarily be limited to Cuba since *Cuban Flint* is not present on any of the other islands. Because of the very recent migration of *Cuban Flint* from Argentina to Cuba and because of the wide distribution of *Coastal Tropical Flint* in eastern South America, it seems more reasonable to suppose that this race is primarily of South American derivation.

Relationship to Previously Described Races

Coastal Tropical Flint is synonymous with the race of the same name previously described by Cutler (7) and by Brown (5). It is also the same as Hatheway's "Maiz Criollo" of Cuba (13). In southeastern United States very similar corns have long been known as "Creole Flint". Although Brieger (3) treats "Tropical" or "Caribbean Flints" only superficially, certain of his subraces of Cateto are very similar to *Coastal Tropical Flint*. As a matter of fact, the ears of Brieger's *Cateto Chaura*, from Rio Grande do Sul, are quite typical of *Coastal Tropical Flint*. He, however, makes no mention of this relationship in his discussion.

Ears typical of *Coastal Tropical Flint* (Criollo) are reported by Hatheway to be present in collections not only from Brazil but from Colombia and Venezuela as well. There are also among the collections from Chile, ear types which are very similar to *Coastal Tropical Flint*.

MAIZ CHANDELLE

Ear photograph, Figure 12
Plant photograph, Figure 13
Internode diagram, Figure 14
Tables 5 and 12

Ears long, slender, strongly compressed at base and gently tapered toward the tip. Ear size and shape suggestive of a candle, thus the name "Chandelle". Kernel rows range from 10 to 16 with a mean number of 12.5. *Chandelle* occurs in two forms, a semi-flint and a dent. Kernels of the semi-flint form are long and narrow and usually terminate in a small cap of soft starch. Kernels pointed. Kernels of the dent form are not pointed, are frequently dented and contain a higher proportion of soft starch than the semi-flint. Endosperm yellow. Pericarp usually colorless. Cobs, particularly those of the dent form, are flexible even when mature and dry. Mid cob is narrow and with a minimum of lignification. Pistillate glumes short, feathery and of soft texture.

Tassels usually exserted although occasionally inserted. Tassel branches upright, of medium length and without condensation. Plants are tallest of the West Indian races (328 cm.) and are of late maturity. Among the collections from Cuba considerable sun red anthocyanin color is present in the leaf sheaths.

Maiz Chandelle is certainly the most distinctive and also one of the most interesting races of maize in the West Indies. Although it occurs in Cuba, Haiti, the Dominican Republic and Trinidad, it is not widely distributed in any of these islands. In Cuba it is found frequently in Oriente Province and less frequently in the eastern part of Camaguey Province. Its distribution in Haiti is limited to the mountainous area of the western part of the southwestern peninsula and in Trinidad it is grown only in the foothills of the northern range of mountains. More recently, maize collected in the Caicos Islands by Dr. Edwin Doran, Jr. has been identified as *Maiz Chandelle* (10). The presence of *Maiz Chandelle* in the Caicos is not surprising in view of the exchange of traits between Haiti and the Bahamas, as pointed out by Dr. Doran.

Wherever *Maiz Chandelle* is grown, the reasons given by farmers for growing it are always the same, i.e. it shells easily

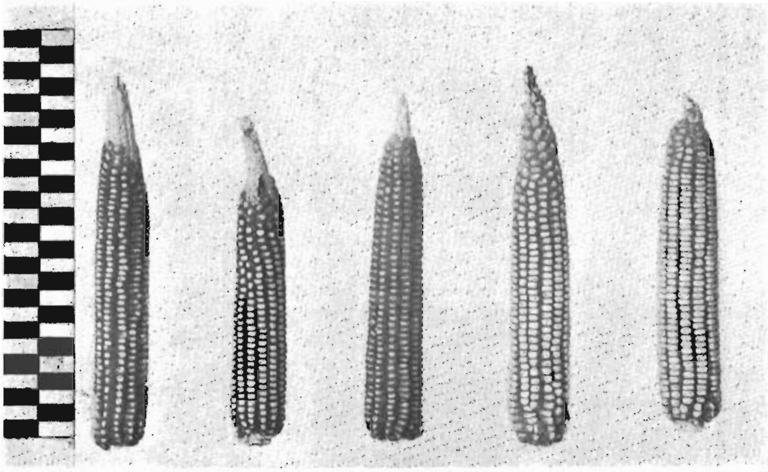
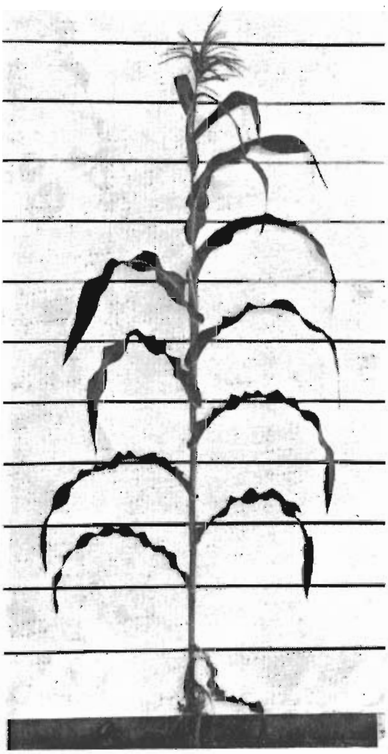


FIG. 12. Typical Ears of Maiz Chandelle.



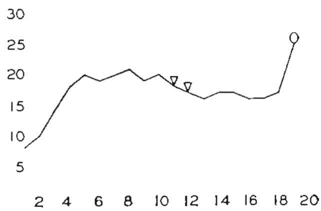


FIG. 14. Internode Diagram of Maiz Chandelle.

FIG. 13. Typical Plant of Maiz Chandelle.

and has a proportionately large amount of grain for the size of the cob. It is also my experience that *Maiz Chandelle* is usually found in the possession of conservative farmers who are long time residents of the communities in which they live.

As mentioned above, *Maiz Chandelle* is found in two forms, a semi-flint and a dent. The former is limited in its distribution to Cuba and Haiti while the latter occurs in Cuba, Dominican Republic and Trinidad. In Cuba the race is known by such names as "maiz cuña", "maiz canilla" and "Tuyuyo". In Haiti it is always known as *Maiz Chandelle* and in Trinidad it is most frequently referred to as "Deer Horn".

In the West Indies, the most typical collections of *Maiz Chandelle* are from Haiti. Since in Haiti the pre-Columbian Arawak practiced a highly developed agriculture one might assume that *Maiz Chandelle* followed the spread of the Arawak from this region. As the Arawak supposedly reached the West Indies from South America and because of the presence of *Maiz Chandelle* in South America, the race is believed to have had its origin on the mainland.

Relationship to Previously Described Races

The name, *Maiz Chandelle,* was used earlier by Brown (5). It is the same as "Canilla" of Hatheway (13) and Races 1 and 2 of Hernández (14). It is also very similar to the race *Clavo* of Colombia (20) and likewise occurs in undescribed collections from Venezuela and Ecuador. Among the collections from Mexico, Panama and El Salvador there are ears which appear to be somewhat contaminated *Maiz Chandelle.* The race, therefore, is widely distributed in South and Middle America as well as the West Indies.

EARLY CARIBBEAN

Ear photograph, Figure 15
Plant photograph, Figure 16
Internode diagram, Figure 17
Tables 6 and 13

Ears approximately 18 cm. in length, slightly tapered, rarely enlarged at the butt. Row numbers 8 to 14 with a mean number of 11.6. Kernels about as wide as long, frequently crescent shaped as in the Northern Flint corns of northeastern United States. Kernels flint or semi-flint, rarely dented. Endosperm yellow. Pericarp frequently red or reddish.

Tassels characteristically have relatively few long and lax branches and are well exserted. Spikelets of the central spike often decussately arranged. Pedicels of the pedicellate spikelets unusually long in comparison to those of other West Indian races.

Plants of *Early Caribbean* are quite unlike those of other West Indian races. They are of very early maturity, flowering approximately six weeks after planting. Their total height is usually not more than one-half or two-thirds that of other races from the same area. Unlike early Mexican races such as *Zapalote Chico*, they are, however, very susceptible to changes in photoperiod. When grown in central United States, for example, *Early Caribbean* does not flower before the onset of shorter day lengths in late summer or early fall. Plants are without tillers and the internodes of the culm retain their length above the ear resulting in an internode pattern quite distinct from that of other West Indian races. Also in contrast to other West Indian races and most other tropical corns, the ears of *Early Caribbean* are enclosed in loose husks which tend to open at maturity.

This race is of limited distribution and so far as is known to the author is found only in Martinique and St. Kitts. At the time our collections were made it was the only maize in cultivation in Martinique where it is used primarily as a catch crop. It is frequently grown between rows of young banana plants and is also planted in combination with peanuts, cassava, beans, etc. The smaller red kernels of *Early Caribbean* are prized as special feed for fighting cocks and are felt to impart unique fighting qualities to those birds. Although likely without any sound basis

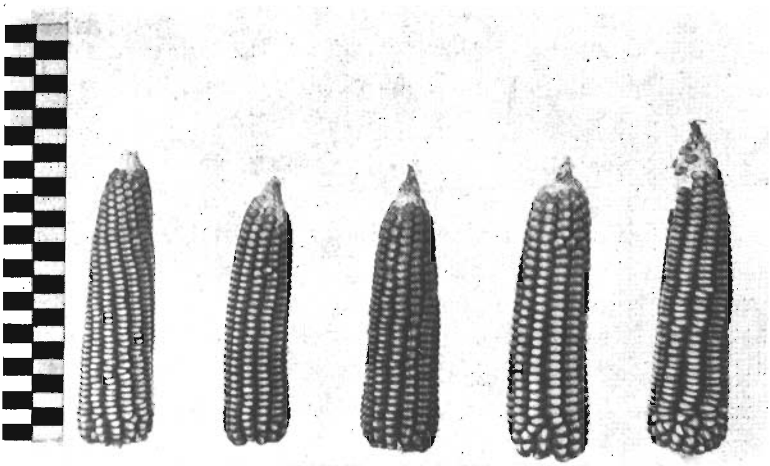
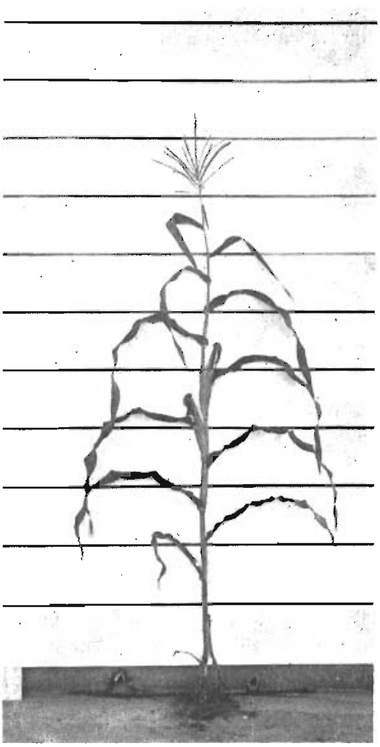


Fig. 15. Typical Ears of Early Caribbean.



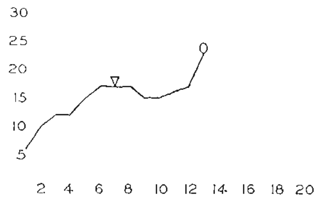


Fig. 17. Internode Diagram of Early Caribbean.

Fig. 16. Typical Plant of Early Caribbean.

in fact, this feeling can be understood when one appreciates the importance of cock fighting not only to the recreational enjoyment of West Indians but to their financial status as well.

As has been suggested earlier (5), *Early Caribbean*, or its progenitors, was probably among the earliest introductions of Western Hemisphere maize into Europe. Finan (11) has shown, as a result of his studies of maize in the great herbals, that among the early descriptions of maize by the herbalists there was a type quite unlike the more common corns of the Caribbean. According to the herbalists, this corn had ears possessing 8 to 10 rows of kernels, few tassel branches, a slender culm and some "flag leaves". It was also lacking prop roots, this in contrast to other types of maize described by the herbalists. Finan recognized the similarity between this and the common flint corns of northeastern United States but was puzzled as to how such a corn could have come from the Caribbean since, at the time of his studies, varieties fitting this description were not known to occur in the West Indies. In most ways *Early Caribbean* fits closely the description of those early European introductions and could very well represent the origin of this group of European corns that have long puzzled historians and maize specialists as well. The ultimate origin of *Early Caribbean* still remains obscure since, so far as I am aware, it is not duplicated in South or Central America. It is similar, in many ways, to northeastern Flint (Eastern Complex) corns. This similarity prompted the author (5), in an earlier paper, to suggest the West Indies as a possible route of dispersal for Eastern Complex maize. Admittedly, there is no archaeological support for such an hypothesis and previous authors (12) have rejected it on the basis of dissimilarity of maize types in the two areas. Yet the evidence that is available does not, it seems, preclude such a possibility. Conversely, one might reason that the similarity between *Early Caribbean* and Eastern Complex is the result of hybridization of the latter with one or more indigenous West Indian varieties. Such might easily have occurred in the Caribbean in historic time since the early New England and Middle Atlantic colonists carried on an extensive trade with the West Indies. Included among their shipments to the islands were considerable quantities of Indian maize. It would be very unlikely that none of this maize was used for seed and if so there was undoubtedly the opportunity of its crossing naturally with local varieties, regardless of how poorly adapted it might have been. Once the original cross had occurred, introgression and natural selection in later generations could very well have culminated in a new race.

Relationship to Previous Described Races

This race is the same as *Early Caribbean* described previously by the author (5). So far as is known it is not closely allied to other West Indian races, nor does it occur among races that have been described for South America, Central America or Mexico.

ST. CROIX

Ear photograph, Figure 18
Plant photograph, Figure 19
Internode diagram, Figure 20
Tables 7 and 14

Ears cylindrical to slightly tapered, longer than those of any other West Indian race. Number of rows of kernels 10 to 14. Kernels large, almost as wide as long and frequently well dented. Kernels usually flat topped, rarely pointed. Endosperm light yellow. Aleurone colorless, rarely light red.

Tassels have relatively few primary branches. Branches arranged more or less at right angles to primary axis. Spikelets slightly condensed. Tassels frequently inserted in the uppermost leaf sheath.

Leaves are wide and relatively short. Ear placement lower than in most West Indian races. Husks usually shorter than the ears and comparatively loose. *St. Croix* is of later maturity than *Early Caribbean* but considerably earlier than other West Indian races.

St. Croix possesses not only a distinct phenotype but also a very limited distribution. So far as is known it is found only in St. Croix although the possibility of its occurrence in the other Virgin Islands cannot be ruled out since they were not visited during the course of this study.

There are distinct similarities between this race and at least two other previously described races or varieties. These are *Olotillo* of Mexico (24) and *Hickory King* of southeastern United States. Although *St. Croix* has a higher mean row number than either of these corns this could easily have resulted from the introgression of local varieties of maize into either *Olotillo* or *Hickory King*. The very limited distribution of *St. Croix* suggests it to be of recent origin. One cannot at this time rule out the possibility of relationship to *Olotillo*-like races of Mexico, yet the close political connection between St. Croix and the United States lends support to the theory that the variety *Hickory King* is most likely involved in the ancestry of this race.

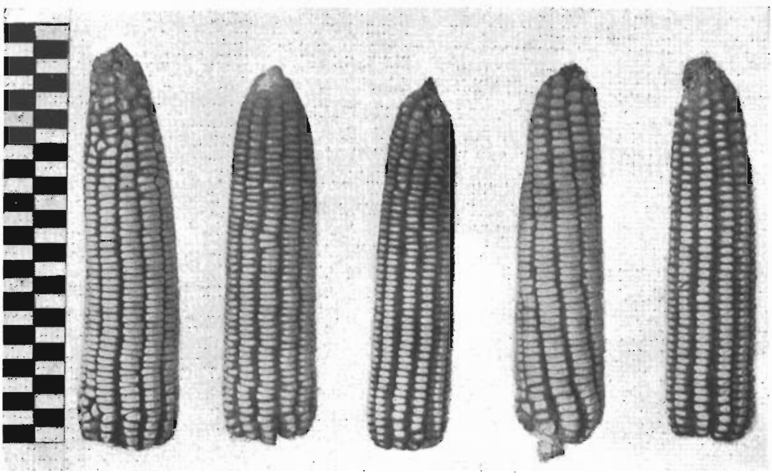
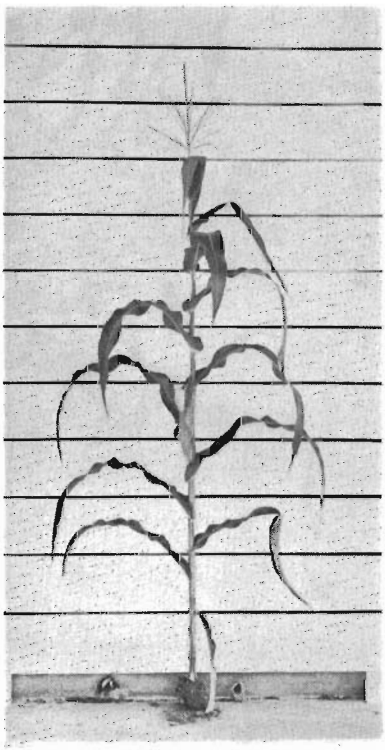


FIG. 18. Typical Ears of St. Croix.



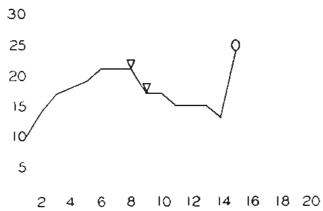


FIG. 20. Internode Diagram of St. Croix.

FIG. 19. Typical Plant of St. Croix.

Relationship to Previously Described races

St. Croix is synonymous with *St. Croix Long Ear,* previously described by Brown (5). Other than the possible relationship mentioned above, *St. Croix* appears not to be duplicated among other described races.

TUŚON

Ear photograph, Figure 21
Plant photograph, Figure 22
Internode diagram, Figure 23
Tables 8 and 15

Ears cylindrical or slightly tapered; 12 to 20 rows of deep yellow kernels. Kernels conspicuously capped with soft starch, occasionally dented. Cobs white and thick. In contrast to most other West Indian races, terminal end of cob is usually covered with grain. Kernels about 11 mm. in length. Pistillate glumes short and of soft texture.

Tassels well exserted, many branched and wide spreading. Tassel branch internodes exhibit little, if any, condensation.

Plants are without tillers. Internodes below the ears are frequently longer than the accompanying leaf sheaths while those above the ear are much condensed. Ears usually placed high on the culm. Most plants exhibit dilute sun red coloration in the leaf sheaths. *Tuśon* is of medium maturity, reaching anthesis about 62 days following planting when grown in areas to which it is adapted.

The name *Tuśon* was first applied by Hatheway (13). It is being adopted here to include both *Cylindrical Dent* and *West Indian Semi Dent* of Brown (5). Additional study leads me to believe that the variation between *West Indian Semi Dent* and *Cylindrical Dent* is continuous and that there is, therefore, no real justification for separating this complex into two racial entities. The name *Tuśon,* meaning "large cob", seems especially fitting for this race since it does possess a larger cob than any of the other West Indian races.

Tuśon has been collected in Cuba, Trinidad, Haiti, Dominica, Jamaica and the Dominican Republic. In Cuba it is found most frequently in the eastern part of the island. It is of rare occurrence in Haiti, Jamaica and Dominica but it is the dominant race of Trinidad.

The author suggested earlier that *Tuśon* probably arose out of crosses between *Coastal Tropical Flint* and some unknown dent corn. This still seems to be the most logical answer to the question of origin of this race. Hatheway (13) has called atten-

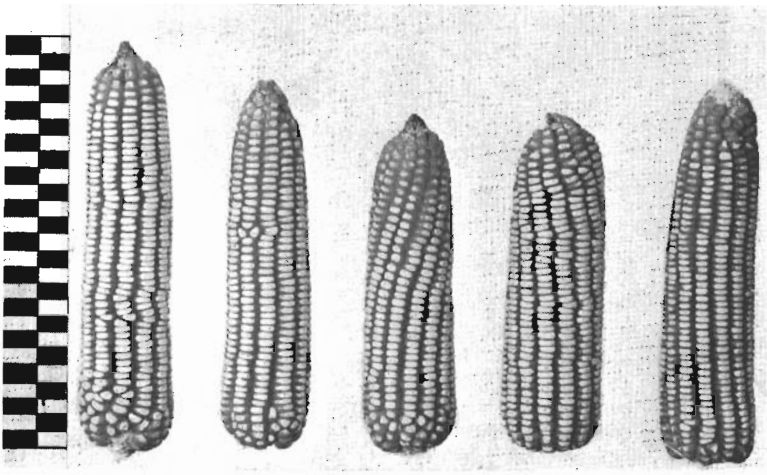
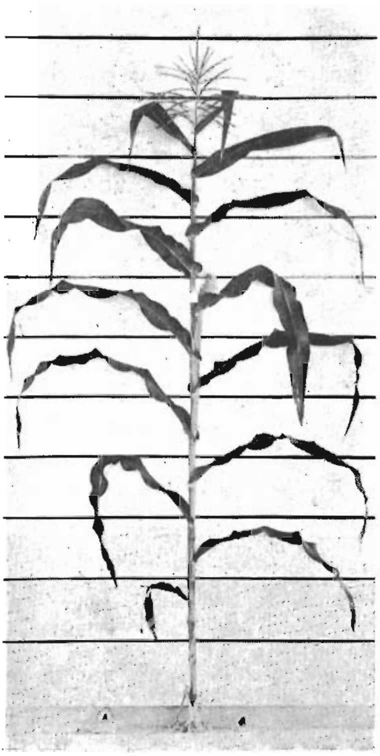


FIG. 21. Typical Ears of Tuśon.



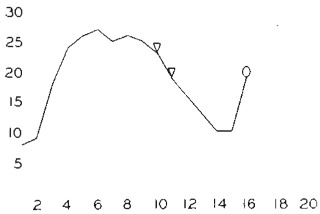


FIG. 23. Internode Diagram of Tuśon.

FIG. 22. Typical Plant of Tuśon.

tion to the similarity of distribution of *Tuśon* and that of the pre-Colombian Caribbean Arawak and suggested, for this reason, that the race was probably introduced by the Arawak from South America. Since similar types of maize are known to occur in South America and since *Coastal Tropical Flint* is common in the eastern coastal areas of the South American mainland it seems reasonable to postulate a South American rather than a West Indian origin for the race.

Compared to other West Indian races, *Tuśon* possesses exceptional vigor and yielding capacity. This probably is in part at least a result of its putative hybrid origin and is, therefore, an expression of true hybrid vigor. Regardless of its origin, it is without doubt the most promising source of desirable maize germ plasm in the West Indies today. It might well be considered the West Indian counterpart of the fabulous yellow dents of the United States corn belt from which United States hybrid maize has been derived. Its usefulness as breeding material has already been demonstrated not only in the West Indies but also in lowland tropical areas of Mexico and South America.

Relationship to Previously Described Races

Tuśon is synonymous with *West Indian Semi Dent* and *Cylindrical Dent* described by Brown (5). It is also the same as Hatheway's *Tuśon* (13). In addition, *Tuśon* is duplicated among undescribed collections from Venezuela and Ecuador.

EXCLUDED RECENTLY INTRODUCED RACES

In addition to the seven races recognized in this study, three additional races have been described as occurring in Cuba (13). These are *White Pop, Yellow Pop* and *White Dent.* While the validity of these races is not questioned, they are excluded from the present treatment for two reasons. Two of these are known to have been only recently introduced into the West Indies and the third, *White Dent,* is probably a chance, recent introduction. Secondly, there is no evidence to indicate that any of these races has had any influence on the evolution of maize in Cuba. The two popcorns are old established varieties from the United States which reached Cuba through seed purchases from the states. *White Dent* was found by Hatheway (13) in the possession of one grower only in Oriente Province. It had not occurred in collections made earlier nor has it been found by subsequent collectors. It seems reasonable to assume, therefore, that it too probably resulted from a seed sample picked up by a single individual from somewhere outside the country. Hatheway believed *White Dent* to be very similar to the race *Zapalote Chico,* originally described from Mexico. If White Dent is actually *Zapalote Chico* it could have reached Cuba either from Mexico or from Venezuela where maize very similar to *Zapalote Chico* has recently been collected.

CHROMOSOME KNOBS

Information on knobs of West Indian races is limited to total knob numbers. This information, admittedly, is less useful than are data pertaining to knob positions, yet it does provide some knowledge of overall cytological differences between races of West Indian maize.

In the material studied, variation in numbers of knobs within races is considerable. In *Cuban Flint* and *Early Caribbean,* for example, numbers range from 4 to 8 and 4 to 9 respectively. However, phenotypically, plants with four knobs were indistinguishable from those with eight or nine.

The highest number of knobs encountered were among the races *Haitian Yellow* and *Tuśon* while the lowest numbers were

TABLE 1. Numbers of chromosome knobs in West Indian Maize

Race	*Plants Studied*	*Range in Numbers*	*Mean Number*	*Remarks*
Cuban Flint	4	4-8	7.0	
Early Caribbean	13	4-9	6.0	
Tusón	5	9-10	9.2	Knobs large
Coastal Trop. Flint	5	6-7	6.8	From *Races of Maize in Cuba*
Haitian Yellow	3	7-10	9.8	Knobs small
St. Croix	6	7-9	8.8	
Maiz Chandelle	7	5-8	6.4	

found among plants of *Cuban Flint* and *Early Caribbean*. Although total knobs were essentially the same in *Tuśon* and *Haitian Yellow*, the size of the knobs in the two races were strikingly different. Knobs of *Tuśon* are characteristically large whereas those of *Haitian Yellow* are very small.

Among the thirteen plants of *Early Caribbean* which were studied cytologically, two were found to possess four knobs only. The occurrence within this race, of plants with few knobs may lend some support to the suggestion made earlier of a possible relationship between *Early Caribbean* and the Eastern Complex corns of North America. These latter corns which were at one time the dominant race of maize throughout eastern North America have been shown to have few if any knobs (4) and, in addition, possess several morphological features in common with *Early Caribbean*.

St. Croix with a mean knob number of 8.8 is within the range of variation of knobs reported for *Hickory King* (6) and is somewhat higher than the number reported for *Olotillo* (24). As mentioned earlier, comparative morphology suggests a possible relationship between *St. Croix* and one or both of these races, one from southern United States and the other from Mexico.

Knob numbers in West Indian maize are summarized in Table 1.

IMPORTANCE OF WEST INDIAN MAIZE TO MODERN MAIZE IMPROVEMENT

Corn breeding, particularly where hybrid corn is of long standing, has reached the stage in its development where further significant increases in yield are difficult to achieve. When faced with this difficulty, the breeder then becomes particularly interested in new breeding techniques and new materials. As a source of the latter, certain of the West Indian races appear to be unusually attractive as has already been demonstrated by breeding experience in several widely scattered parts of the world.

As was mentioned previously, the race *Tuśon* is perhaps one of the Western Hemisphere's most valuable sources of maize germ plasm. As a variety it has unusually high yield potential and in addition possesses a considerable amount of resistance to leaf blight (*Helminthosporium* species) and tropical rust (*Puccinia polysora*). Furthermore, it has excellent grain quality, including resistance to ear rot, better than average stalk quality and attractive appearance. The high yielding capacity of *Tuśon* is most likely due in part to its hybrid origin and is a direct expression, therefore, of true hybrid vigor. In contrast to many races of Latin American maize which due to their isolation over long periods of time are actually relatively pure strains, *Tuśon* is both heterogeneous and heterozygous. It probably arose out of crosses between an unknown dent and *Coastal Tropical Flint* and may therefore be considered a West Indian counterpart of the common yellow dent corn of the United States corn belt. West Indian maize has been used widely in maize improvement schemes in various parts of the world. It is still too early to assess with accuracy the real value of this material, yet the several summaries of experience listed below suggests it to be a most important resource with respect to maize improvement. Much of the information which follows is unpublished but has been made available by the International Cooperation Administration and through its many field workers. The author is particularly indebted to Mr. Claud L. Horn of I. C. A. with the U. S. D. A. for his aid and willing cooperation in accumulating much of the information presented in the succeeding paragraphs.

Philippines

Cuban Yellow Flint was introduced into the Philippines about 1935. It has proven to be an invaluable source of diversity among yellow endosperm hybrids. All of the yellow flint Philippine hybrids are crosses between singles of *Cuban Yellow Flint* and College Yellow Flint, a local variety.

Peru

Cuban Yellow was introduced in Peru in 1944 or 1945. It has ranked consistently among the highest yielding varieties at the Tingo Maria Experiment Station. Because of its high yield and other desirable characteristics *Cuban Yellow* was released for commercial production to farmers of the Central Huallaga Valley in 1948. After three to five years practically no other corn was grown in this area.

Bolivia

Cuban Yellow was introduced through the experiment station near Santa Cruz in 1951. Because of its increased yields over local varieties it replaced all native corn within two years after its release. The success of the newly introduced corn, however, created a new problem. Because the high return per hectare, farmers increased their acreage appreciably and this combined with higher yields resulted in a saturation of the local market for corn.

Central America

The Cuban hybrids developed by Dr. Carlos del Valle, Cornelli 11, 31 and 54, have been tested quite extensively in Central America. These hybrids are combinations of lines derived largely from West Indian races. In 1955 hybrid number 11 in comparison with seventeen varieties and tested in six countries ranked third in Guatemala, sixth in El Salvador, first in Honduras, first in Nicaragua, fourth in Costa Rica and first in Panama. Yields of the Cuban hybrid range from 9 to 57 percent beyond that of local varieties. In 1956, Cuban hybrid 11 tested in comparison with fifteen varieties ranked either first or second in each of six Central American countries.

Indonesia

Dr. R. I. Jackson (15) has reported that introductions from Central America and more particularly Cuba provided the foundation material for the corn improvement project in Indonesia. Among the most useful materials has been Tequisate Golden Yellow which apparently consists in part at least of Cuban germ plasm.

Colombia

Although West Indian races have apparently been used very little as varieties in Colombia they have proved to be some of the better sources of breeding materials for lowland tropical areas of that country. The synthetic Eto, developed at Granja Tulio Ospina, at Medellín, obviously contains an appreciable amount of West Indian germ plasm, obtained either directly from the West Indies or from Venezuela This synthetic has proved to be not only one of the highest yielding varieties in Colombia but has also been found to be an excellent source of inbred lines. In addition to Eto itself, Colombian breeders have found races and varieties from the West Indies among the most promising sources of materials for use in developing improved corns for their lowland areas.

Africa

A number of West Indian corns along with others from Mexico and South America have been shown to be of considerable value as sources of resistance to the tropical rust, *Puccinia polysora.* An outbreak of *Puccinia polysora* in West Africa a few years ago resulted in severe reduction in maize yields. In their effort to combat the disease, workers in West Africa surveyed a large number of strains of maize from the Western Hemisphere. According to Dr. W. R. Stanton (personal communication) two synthetics, one developed from lines of Trinidad origin and another from Mexican materials, were distributed to farmers and now dominate or have conferred rust resistance to most of the forest maize types from a point west of the Niger to the Cote d'Ivoire border.

North America

West Indian germ plasm is undoubtedly of greatest immediate value to breeding in tropical areas. It is unlikely, however, that its usefulness is limited to the tropics. A synthetic consisting of more or less equal parts of West Indian and the United States corn belt varieties has been grown in the central and southern parts of the United States corn belt for six generations. While it is yet too early to determine how useful this material may be in improving corn belt maize, it appears to be among the more promising of several sources of exotic germ plasm currently being investigated.

SUMMARY

1. This report is based on a study of 135 accessions of West Indian maize collected from eleven islands. Progenies of each of the collections were grown and studied in Trinidad, B.W.I. Despite the heterogeneous nature of the material it has been possible to recognize seven more or less distinct races. Four of these *Cuban Flint, Coastal Tropical Flint, Maiz Chandelle* and

Tuśon, are believed to have reached the West Indies from South America. Another (*St Croix*) probably came from Mexico either directly or via southern United States. The origin of *Early Caribbean* and *Haitian Yellow* is obscure and appear not to be closely related to previously described races. Not all varieties of maize of the West Indies can be assigned to the seven races described. Hybridization between varieties, both currently and in the past, has resulted in numerous mixtures, many of which are more or less intermediate between certain of the described races.

2. General descriptions, tabular data on ears, plants and tassels, internode diagrams and photographs of typical ears and plants are included for each race.

3. A brief history of the recognized ethnic groups of the West Indies is presented and related to the evolution of maize of the area.

4. Although the number of distinct races found in the West Indies is comparatively few, maize of the area is important for several reasons. It probably provided the source of the first maize introductions into Europe and from there has been distributed widely to various parts of the world. The complex evolutionary history which much of West Indian maize has undergone has resulted in its becoming a particularly promising gene pool for further maize improvement. Several specific examples are cited supporting this assertion.

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APPENDIX

TABLE 2. Characters of the Ear of Cuban Flint

Ear Number	*Basal Diameter mm.*	*Mid Ear Diameter mm.*	*Shank Diameter mm.*	*Kernel Width mm.*	*Kernel Thickness mm.*	*Kernel Length mm.*	*Ear Length cm.*	*Row Number*	*Denting*	*Pericarp Color*	*Pointing*	*Endosperm Color*	*Source*
1	54	48	22	9	46	9	21	14	0	Colorless	1	Orange	Mayari, Cuba
2	45	43	18	8	37	10	20	14	0	Colorless	1	Orange	Mayari, Cuba
3	45	41	18	9	37	10	16	12	0	Colorless	2	Orange	Mayari, Cuba
4	47	45	19	8	42	8	18	16	0	Colorless	1	Orange	Mayari, Cuba
5	48	45	19	8	37	9	17	16	0	Colorless	1	Orange	Mayari, Cuba
6	48	44	19	9	41	8	23	14	0	Colorless	1	Orange	Mayari, Cuba
7	41	41	13	9	42	10	14	14	0	Colorless	1	Orange	Mayari, Cuba
8	49	45	16	8	40	9	16	16	0	Colorless	1	Orange	Mayari, Cuba
9	48	45	17	9	36	11	16	14	0	Colorless	1	Orange	Mayari, Cuba
10	48	46	19	9	35	10	18	14	1	Colorless	1	Orange	Mayari, Cuba
11	54	47	23	10	40	9	18	12	0	Colorless	1	Orange	Mayari, Cuba
12	49	44	17	8	39	9	17	16	1	Colorless	1	Orange	Mayari, Cuba
13	54	49	17	9	42	10	19	16	0	Colorless	2	Orange	Mayari, Cuba
14	47	45	18	9	35	8	16	14	0	Colorless	1	Orange	Mayari, Cuba
15	45	42	12	9	38	8	19	12	0	Colorless	1	Orange	Mayari, Cuba
16	46	42	16	10	32	8	19	12	0	Colorless	1	Orange	Mayari, Cuba
17	48	46	11	9	35	10	16	14	0	Colorless	1	Orange	Mayari, Cuba
18	45	44	16	9	41	10	14	14	0	Colorless	1	Orange	Mayari, Cuba
19	48	48	14	9	36	11	16	16	0	Colorless	1	Orange	Mayari, Cuba
20	50	46	20	10	40	9	22	14	1	Colorless	1	Orange	Mayari, Cuba
21	50	46	13	8	44	10	16	16	1	Colorless	1	Yellow	Madruga, Cuba
22	50	45	15	9	35	10	16	14	1	Colorless	2	Orange	Madruga, Cuba
23	46	42	16	8	37	10	15	14	0	Colorless	1	Yellow	Madruga, Cuba
24	47	44	15	10	36	10	17	14	1	Colorless	1	Orange	Madruga, Cuba
25	50	43	15	9	37	10	18	14	1	Colorless	1	Orange	Madruga, Cuba
Mean	48.0	44.2	16.7	8.8	38.4	9.4	17.4	14.2	0.2		1.1		

TABLE 3. Characters of the Ear of Haitian Yellow

Ear Number	*Basal Diameter mm.*	*Mid Ear Diameter mm.*	*Shank Diameter mm.*	*Kernel Width mm.*	*Kernel Thickness mm.*	*Kernel Length mm.*	*Ear Length cm.*	*Row Number*	*Denting*	*Pericarp Color*	*Pointing*	*Endosperm Color*	*Source*
1	54	48	21	10	35	10	18	12	2	Colorless	3	Yellow, few white	Marfranc, Haiti
2	47	43	19	9	35	10	16	12	1	Colorless	3	Yellow, white	Marfranc, Haiti
3	45	37	16	9	34	8	15	12	2	Colorless	2	Yellow	Marfranc, Haiti
4	43	40	20	10	38	9	19	10	1	Colorless	2	Yellow	Marfranc, Haiti
5	46	42	15	9	37	9	17	12	1	Bronze	3	Yellow	Marfranc, Haiti
6	41	39	15	8	37	9	19	12	1	Colorless	3	Yellow	Josapha, Haiti
7	42	39	17	8	39	9	19	12	2	Colorless	2	Yellow	W of Jeremie, Haiti
8	49	41	21	11	41	9	19	10	2	Colorless	2	Yellow	W of Jeremie, Haiti
9	48	41	21	11	41	9	20	10	1	Colorless	2	Yellow	W of Jeremie, Haiti
10	51	45	19	9	32	11	18	14	1	Colorless	3	Yellow, white	SW of Moron, Haiti
11	51	42	17	11	40	10	19	8	2	Bronze	2	Yellow	Moron, Haiti
12	45	39	18	9	29	9	19	12	1	Colorless	2	Yellow	Moron, Haiti
13	46	39	19	9	42	10	18	12	2	Colorless	3	Yellow	Moron, Haiti
14	48	40	17	10	31	10	19	12	1	Colorless	2	Yellow	Moron, Haiti
15	46	39	20	9	40	10	19	12	1	Colorless	2	Yellow	W of Moron, Haiti
16	45	41	19	10	36	10	20	10	1	Colorless	3	Yellow	Marfranc, Haiti
17	50	42	20	10	39	10	18	12	1	Colorless	2	Yellow	Marfranc, Haiti
18	42	38	18	9	42	10	20	12	1	Colorless	2	Yellow	Marfranc, Haiti
19	46	40	19	9	37	8	17	12	1	Colorless	3	Yellow	Marfranc, Haiti
20	51	42	17	9	39	9	17	12	1	Colorless	3	Yellow	W of Moron, Haiti
21	49	41	18	9	39	9	20	12	1	Red	3	Yellow, white	Moron, Haiti
22	47	39	19	10	36	9	20	10	2	Colorless	2	Yellow	Camp Perrin, Haiti
23	47	39	19	9	39	10	18	10	1	Colorless	3	Yellow	Camp Perrin, Haiti
24	43	36	19	10	34	9	19	8	1	Colorless	2	Yellow	Camp Perrin, Haiti
25	42	35	15	10	34	9	17	8	1	Colorless	2	Yellow	Nr. Moron, Haiti
Mean	43.8	40.7	14.8	9.4	44.2	9.4	18.0	11.6	1.2		1.0		

TABLE 4. Characters of the Ear of Coastal Tropical Flint

Ear Number	*Basal Diameter mm.*	*Mid Ear Diameter mm.*	*Shank Diameter mm.*	*Kernel Width mm.*	*Kernel Thickness mm.*	*Kernel Length mm.*	*Ear Length cm.*	*Row Number*	*Denting*	*Pericarp Color*	*Pointing*	*Endosperm Color*	*Source*
1	46	44	20	9	42	10	24	14	1	Colorless	1	Yellow	Dominica
2	48	44	17	10	46	9	24	12	1	Colorless	1	Yellow	Dominica
3	55	49	20	9	47	9	22	14	1	Colorless	1	Yellow	Dominica
4	53	52	16	9	42	10	22	18	1	Colorless	1	Yellow	Dominica
5	44	45	15	8	47	9	19	18	1	Colorless	1	Yellow	Dominica
6	46	47	16	9	42	9	24	14	1	Colorless	1	Yellow	Dominica
7	44	47	20	9	48	9	18	14	1	Slight	1	Yellow	Dominica
8	45	45	16	8	38	9	20	16	1	Colorless	1	Yellow	Dominica
9	43	43	17	9	39	9	18	12	1	Colorless	1	Yellow	Dominica
10	49	46	20	9	50	10	20	16	1	Colorless	1	Yellow	Dominica
11	45	45	17	9	38	9	19	14	1	Colorless	1	Yellow	Dominica
12	48	46	16	8	38	9	19	16	1	Colorless	1	Yellow	Dominica
13	42	43	16	8	45	8	20	14	9	Colorless	1	Yellow	Dominica
14	49	49	16	8	43	9	20	18	1	Colorless	1	Yellow	Dominica
15	43	42	15	8	43	8	18	16	1	Colorless	1	Yellow	Dominica
16	42	42	17	9	41	9	19	12	1	Colorless	1	Yellow	Dominica
17	49	48	19	7	44	10	21	16	1	Slight	1	Yellow	Dominica
18	49	45	21	9	49	10	25	14	1	Colorless	1	Yellow	Dominica
19	44	43	16	9	46	9	27	12	1	Colorless	1	Yellow	Dominica
20	46	46	19	10	51	10	24	14	1	Colorless	1	Yellow	Dominica
21	52	49	21	9	45	10	21	16	1	Colorless	1	Yellow	Dominica
22	46	45	20	9	42	9	19	14	1	Colorless	1	Yellow	Dominica
23	53	51	21	9	50	9	23	16	1	Colorless	1	Yellow	Dominica
24	48	46	21	8	45	9	19	16	1	Colorless	1	Yellow	Dominica
25	42	40	21	9	43	9	20	12	1	Colorless	1	Yellow	Dominica
Mean	46.8	45.6	18.1	8.7	44.1	9.2	21.0	14.7	0.8		1.0		

TABLE 5. Characters of the Ear of Maiz Chandelle

Ear Number	*Basal Diameter mm.*	*Mid Ear Diameter mm.*	*Shank Diameter mm.*	*Kernel Width mm.*	*Kernel Thickness mm.*	*Kernel Length mm.*	*Ear Length cm.*	*Row Number*	*Denting*	*Pericarp Color*	*Pointing*	*Endosperm Color*	*Source*
1	29	31	8	5	46	11	21	16	2	Colorless	1	Yellow	Nr. Moron, Haiti
2	27	30	11	6	51	10	22	14	2	Colorless	1	Yellow	Nr. Moron, Haiti
3	30	33	9	7	45	10	24	12	2	Colorless	2	Yellow	Nr. Moron, Haiti
4	32	32	12	8	46	10	17	10	2	Colorless	3	Yellow	Nr. Moron, Haiti
5	34	35	10	8	40	10	20	10	1	Red	2	Yellow	Nr. Moron, Haiti
6	31	32	9	7	40	10	21	12	2	Colorless	1	Yellow	Nr. Moron, Haiti
7	32	36	11	6	34	11	17	16	2	Colorless	1	Yellow	Nr. Moron, Haiti
8	26	26	9	7	38	10	18	10	1	Colorless	2	Yellow	Nr. Moron, Haiti
9	34	31	9	7	39	10	19	12	2	Colorless	2	Yellow	Nr. Moron, Haiti
10	30	31	9	6	40	10	18	14	1	Colorless	1	Yellow	Nr. Moron, Haiti
11	34	35	9	8	34	10	18	12	1	Colorless	1	Yellow	Nr. Moron, Haiti
12	27	29	9	6	38	9	15	12	2	Colorless	1	Yellow	Nr. Moron, Haiti
13	38	36	14	8	39	11	18	12	1	Colorless	2	Yellow	Nr. Moron, Haiti
14	33	34	11	8	37	11	19	12	2	Slight	1	Yellow	Tacamala, Cuba
15	30	34	9	7	36	12	20	12	1	Colorless	1	Yellow	Mayari, Cuba
16	33	34	11	8	49	11	23	12	1	Colorless	2	Yellow	Victoria de las Tunis, Cuba
17	33	34	10	8	43	11	21	12	1	Colorless	1	Yellow	Cartaches, Haiti
18	33	35	11	8	38	10	22	12	2	Colorless	1	Yellow	Petit-Ange, Haiti
19	32	36	9	8	37	12	21	12	1	Colorless	1	Yellow	Nr. Holguin, Cuba
20	33	36	11	7	38	12	18	14	3	Colorless	1	Yellow	Barajagua, Cuba
21	31	33	7	7	39	11	21	14	2	Colorless	1	Yellow	Barajagua, Cuba
22	31	32	12	6	39	11	20	14	1	Colorless	1	Yellow	Petit-Ange, Haiti
23	32	34	7	7	36	12	19	12	2	Colorless	1	Yellow	La Vega, D. Rep.
24	31	37	7	7	47	13	19	14	2	Colorless	1	Yellow	Santiago, D. Rep.
25	40	35	11	7	37	11	20	12	2	Colorless	1	Yellow	Nr. Moron, Haiti
Mean	31.8	33.2	9.8	7.0	40.2	10.7	19.6	12.5	1.6		1.3		

TABLE 6. Characters of the Ear of Early Caribbean

Ear Number	Basal Diameter mm.	Mid Ear Diameter mm.	Shank Diameter mm.	Kernel Width mm.	Kernel Thickness mm.	Kernel Length mm.	Ear Length cm.	Row Number	Denting	Pericarp Color	Pointing	Endosperm Color	Source
1	43	41	15	9	48	9	16	12	2	Colorless	1	Yellow	Martinique
2	46	43	15	9	45	9	16	14	2	Red	1	Yellow	Martinique
3	43	40	13	9	39	9	14	12	2	Colorless	1	Yellow	Martinique
4	49	46	18	10	48	9	15	12	1	Red	1	Yellow	Martinique
5	44	42	14	9	42	10	17	12	1	Colorless	1	Yellow	Martinique
6	45	41	13	9	40	10	16	12	1	Red	1	Yellow	Martinique
7	44	41	13	9	50	10	19	12	1	Red	1	Yellow	Martinique
8	45	41	14	9	49	9	18	12	1	Red	2	Yellow	Martinique
9	46	44	15	9	48	10	20	14	1	Red	1	Yellow	Martinique
10	41	39	14	9	46	9	16	12	1	Red	1	Yellow	Martinique
11	46	40	16	10	37	10	16	10	1	Red	1	Yellow	Martinique
12	39	37	15	11	41	9	17	8	1	Red	1	Yellow	Martinique
13	46	44	15	10	43	10	20	12	1	Red	1	Yellow	Martinique
14	46	42	18	8	38	9	18	14	1	Red	1	Yellow	Martinique
15	45	43	13	9	43	10	19	14	1	Red	1	Yellow	Martinique
16	42	40	15	9	41	9	17	12	2	Red	1	Yellow	Martinique
17	42	38	16	9	48	9	19	12	1	Colorless	1	Yellow	Martinique
18	39	34	14	10	45	9	19	8	1	Red	1	Yellow	Martinique
19	38	37	13	9	41	9	17	10	1	Red	2	Yellow	Martinique
20	41	39	16	9	46	9	18	12	1	Red	1	Yellow	Martinique
21	42	41	13	9	45	11	21	12	2	Red	1	Yellow	Martinique
22	42	40	16	9	42	10	23	12	2	Red	1	Yellow	Martinique
23	46	43	13	11	46	11	18	10	2	Red	1	Yellow	Martinique
24	49	40	19	11	49	9	21	10	0	Red	1	Yellow	Martinique
25	45	42	15	11	46	9	21	10	1	Red	1	Yellow	Martinique
Mean	43.8	40.7	14.8	9.4	44.2	9.4	18.0	11.6	1.2		1.0		

TABLE 7. Characters of the Ear of St. Croix

Ear Number	*Basal Diameter mm*	*Mid Ear Diameter mm.*	*Shank Diameter mm.*	*Kernel Width mm.*	*Kernel Thickness mm.*	*Kernel Length mm.*	*Ear Length cm.*	*Row Number*	*Denting*	*Pericarp Color*	*Pointing*	*Endosperm Color*	*Source*
1	57	54	23	12	47	13	26	12	3	Red	1	Yellow	St. Croix, Virgin Is.
2	51	51	18	11	41	11	22	12	3	Slight	1	Yellow	St. Croix, Virgin Is.
3	49	49	17	11	47	13	21	12	2	Slight	1	Yellow	St. Croix, Virgin Is.
4	49	50	20	12	45	13	24	12	4	Slight	1	Yellow	St. Croix, Virgin Is.
5	53	51	20	11	45	13	20	12	3	Slight	1	Yellow	St. Croix, Virgin Is.
6	48	49	19	11	40	11	21	10	2	Slight	1	Yellow	St. Croix, Virgin Is.
7	55	51	21	12	38	11	22	12	4	Colorless	1	Yellow	St. Croix, Virgin Is.
8	44	49	16	11	43	12	20	12	2	Slight	1	Yellow	St. Croix, Virgin Is.
9	47	50	18	11	55	11	25	12	2	Colorless	1	Yellow	St. Croix, Virgin Is.
10	49	50	20	14	48	12	27	10	2	Red	1	Yellow	St. Croix, Virgin Is.
11	50	53	18	11	41	11	17	14	3	Slight	1	Yellow	St. Croix, Virgin Is.
12	54	54	21	11	47	15	22	14	3	Slight	1	Yellow	St. Croix, Virgin Is.
13	53	53	23	11	43	12	20	12	2	Red	1	Yellow	St. Croix, Virgin Is.
14	48	48	16	9	38	11	20	14	3	Colorless	1	Yellow	St. Croix, Virgin Is.
15	50	49	19	11	42	13	23	12	3	Colorless	1	Yellow	St. Croix, Virgin Is.
16	56	52	22	13	40	12	26	10	4	Slight	1	Yellow	St. Croix, Virgin Is.
17	50	49	18	11	46	11	28	12	1	Red	1	Yellow	St. Croix, Virgin Is.
18	45	48	18	11	54	11	23	12	2	Red	1	Yellow	St. Croix, Virgin Is.
19	51	50	20	10	58	11	24	14	1	Red	2	Yellow	St. Croix, Virgin Is.
20	48	48	17	11	49	12	21	12	2	Red	1	Yellow	St. Croix, Virgin Is.
21	54	54	19	10	40	12	21	14	2	Slight	2	Yellow	St. Croix, Virgin Is.
22	48	48	17	10	54	11	28	12	2	Red	1	Yellow	St. Croix, Virgin Is.
23	56	56	22	11	47	12	23	14	3	Slight	1	Yellow	St. Croix, Virgin Is.
24	48	52	17	10	39	12	22	12	3	Slight	1	Yellow	St. Croix, Virgin Is.
25	51	51	17	9	56	11	27	14	3	Slight	1	Yellow	St. Croix, Virgin Is.
Mean	50.5	50.7	19.0	11.0	45.7	11.8	22.9	12.4	2.5		1.0		

TABLE 8. Characters of the Ear of Tusón

Ear Number	*Basal Diameter mm.*	*Mid Ear Diameter mm.*	*Shank Diameter mm.*	*Kernel Width mm.*	*Kernel Thickness mm.*	*Kernel Length mm.*	*Ear Length cm.*	*Row Number*	*Denting*	*Pericarp Color*	*Pointing*	*Endosperm Color*	*Source*
1	60	56	20	10	46	11	21	14	2	Colorless	1	Yellow	Holguin, Cuba
2	62	51	22	9	44	12	19	16	2	Colorless	1	Yellow	20 ki. W of Holguin, Cuba
3	51	55	17	10	46	13	23	14	2	Colorless	1	Orange	Piarco, Trinidad
4	53	52	18	11	40	11	22	12	2	Colorless	1	Orange	St. Augustine, Trinidad
5	55	54	18	10	46	11	17	14	2	Colorless	1	Orange	St. Augustine, Trinidad
6	53	51	17	10	44	11	25	14	2	Colorless	1	Orange	St. Augustine, Trinidad
7	58	52	22	10	39	12	20	14	2	Colorless	1	Yellow	Holguin, Cuba
8	59	59	19	11	42	12	21	14	2	Colorless	1	Orange	St. Augustine, Trinidad
9	56	53	22	10	44	11	20	14	2	Colorless	1	Orange	Nr. S. Grande, Trinidad
10	49	48	18	10	35	12	21	12	2	Colorless	1	Orange	5 mi. S of S. Grande, Trin.
11	52	51	21	11	41	13	25	12	2	Colorless	1	Orange	S. Grande, Trinidad
12	52	49	13	9	40	12	19	14	2	Colorless	1	Orange	S. Grande, Trinidad
13	51	51	16	10	43	12	20	14	2	Colorless	1	Orange	S. Grande, Trinidad
14	54	52	20	10	41	12	21	14	2	Colorless	1	Orange	Nr. St. Augustine, Trin.
15	50	49	17	9	38	12	20	14	2	Colorless	1	Orange	Nr. Piarco, Trinidad
16	55	50	21	11	41	11	22	12	2	Colorless	1	Orange	Nr. Piarco, Trinidad
17	51	49	16	10	42	11	21	12	1	Colorless	1	Orange	S. Grande, Trinidad
18	56	53	19	11	42	13	27	12	3	Colorless	1	Orange	Trinidad
19	57	53	20	10	37	13	23	14	2	Colorless	1	Orange	Trinidad
20	54	52	20	10	44	11	23	12	2	Colorless	1	Orange	Trinidad
21	60	59	20	10	40	12	21	14	2	Colorless	1	Orange	Trinidad
22	56	53	19	10	43	12	21	14	2	Colorless	1	Orange	Trinidad
23	54	51	15	9	48	11	21	14	2	Colorless	1	Orange	Central Trinidad
24	48	45	16	10	40	12	22	12	2	Colorless	1	Orange	Central Trinidad
25	56	51	20	10	44	12	25	14	2	Colorless	1	Orange	Central Trinidad
Mean	54.4	51.9	18.6	10.0	42.0	11.8	21.6	13.4	2.0		1.0		

TABLE 9. Characters of the Plant of Cuban Flint

Plant No.	*Days to Anthesis*	*Plant Height cm.*	*Length Husk Leaf Blades cm.*	*No. Primary Tassel Branches*	*No. Secondary Tassel Branches*	*No. Tertiary Tassel Branches*	*Length Central Spike cm.*	*Diameter Tassel Peduncle mm.*	*Tassel Exsertion cm.*	*Angle of Tassel Branches*	*Conden-sation*
1			0	20	4	0	28	7	9	2	.0
2			0	19	9	1	24	7	11	3	.0
3			0	22	5	0	23	6	6	2	.0
4			0	19	6	0	24	6	7	2	.0
5			0	27	5	0	20	6	9	2	.0
6			0	17	3	0	26	6	10	3	.0
7			0	28	5	0	23	5.5	5	2	.0
8			2	16	1	0	25	6	7	3	2.0
9			2	13	3	0	25	6	9	2	.0
10			0	17	3	0	23	6	6	2	.0
11			0	16	6	1	24	7	11	2	1.5
12			0	20	7	1	23	6	8	2	1.3
13			0	18	6	0	23	7	12	2	1.5
14			0	21	4	0	26	6	9	2	1.0
15			2	18	5	0	30	7	12	2	1.5
16			0	24	8	0	30	7.5	9	1	1.1
17			0	17	4	0	25	7.5	11	2	1.1
18			0	23	8	2	21	6	9	3	1.2
19			0	19	4	0	26	8	13	2	1.1
20			0	23	7	0	23	6.5	0	2	1.0
Mean	60	235	0.3	19.85	5.25	0.25	24.6	6.5	8.65	2.15	0.71

TABLE 10. Characters of the Plant of Haitian Yellow

Plant No.	Days to Anthesis	Plant Height cm.	Length Husk Leaf Blades cm.	No. Primary Tassel Branches	No. Secondary Tassel Branches	No. Tertiary Tassel Branches	Length Central Spike cm.	Diameter Tassel Peduncle mm.	Tassel Exsertion cm.	Angle of Tassel Branches	Condensation
1			13	21	12	0	—	8	0	1	0.0
2			8	22	11	0	25	8.5	2	3	1.4
3			3	16	7	0	25	7	2	2	.0
4			2	20	10	0	30	7.5	0	3	1.1
5			11	17	9	0	27	8	1	3	.0
6			0	22	18	4	22	7	2	2	.0
7			0	20	8	0	24	5	6	2	.0
8			0	23	10	0	30	7	6	2	1.5
9			4	20	8	0	27	8	1	3	.0
10			3	28	7	0	25	7	3	2	.0
11			5	24	8	0	30	8	5	2	.0
12			0	22	8	0	31	7	5	3	.0
13			4	26	6	0	27	8	5	3	.0
14			0	26	4	0	23	8	0	3	.0
15			2	21	5	0	21	6	6	2	.0
16			2	19	8	0	24	7	0	3	.0
17			0	20	14	2	—	8	3	2	1.5
18			2	19	8	0	27	7	0	3	.0
19			2	22	4	0	30	7	0	3	.0
20			4	26	13	3	21	7	3	2	1.3
Mean	74	299	3.25	21.7	8.9	0.45	26.06	7.3	2.5	2.45	.34

TABLE 11. Characters of the Plant of Coastal Tropical Flint

Plant No.	*Days to Anthesis*	*Plant Height cm.*	*Length Husk Leaf Blades cm.*	*No. Primary Tassel Branches*	*No. Secondary Tassel Branches*	*No. Tertiary Tassel Branches*	*Length Central Spike cm.*	*Diameter Tassel Peduncle mm.*	*Tassel Exsertion cm.*	*Angle of Tassel Branches*	*Conden-sation*
1			0	35	15	1	26	9	6	1	1.8
2			0	25	14	0	29	7.5	5	2	.0
3			0	23	10	0	29	7	6	2	.0
4			0	25	10	0	30	8	7	3	1.6
5			0	27	5	0	28	8	4	3	.0
6			0	28	4	0	24	7	7	2	.0
7			0	29	15	0	16	8	3	3	.0
8			0	30	12	0	27	7.5	6	2	.0
9			0	26	13	0	29	7.5	7	2	.0
10			0	28	11	0	32	8	2	2	.0
11			0	19	10	0	16	6	2	3	1.5
12			0	29	10	0	29	7	3	2	1.0
13			0	17	5	0	27	5	8	2	1.0
14			0	31	10	0	25	7	2	2	1.3
15			0	30	10	0	28	7.5	8	2	1.3
16			0	28	12	0	24	8	3	2	1.1
17			0	20	12	0	29	8.6	7	2	1.5
18			0	24	10	0	30	6.5	0	2	1.0
19			0	27	8	0	29	7.5	3	2	1.7
20			0	27	6	0	28	8.0	3	2	1.5
Mean	68	289	0	26.4	10.1	0.05	26.75	7.43	4.6	2.15	.815

TABLE 12. Characters of the Plant of Maiz Chandelle

Plant No.	Days to Anthesis	Plant Height cm.	Length Husk Leaf Blades cm.	No. Primary Tassel Branches	No. Secondary Tassel Branches	No. Tertiary Tassel Branches	Length Central Spike cm.	Diameter Tassel Peduncle mm.	Tassel Exsertion cm.	Angle of Tassel Branches	Condensation
1			0	23	7	0	30	6	14	3	1.3
2			0	26	15	0	27	8	0	3	.0
3			2	23	16	0	20	9	4	3	.0
4			9	23	13	0	32	7.5	1	2	.0
5			0	20	5	0	—	7	7	2	.0
6			0	22	12	0	19	7	4	2	1.2
7			0	18	7	0	27	7.5	6	3	.0
8			0	23	16	0	21	7	5	2	.0
9			0	17	9	1	25	6	4	2	.0
10			0	20	13	1	28	7	5	2	.0
11			10	24	10	1	26	9	5	3	1.5
12			0	26	16	1	26	8.5	4	2	.0
13			0	23	15	2	21	7	8	3	.0
14			0	27	12	0	26	6	4	3	1.3
15			4	24	9	0	24	8.5	6	3	.0
16			0	16	8	0	28	6.5	8	3	.0
17			5	24	6	0	25	9	8	3	.0
18			7	18	5	0	26	8	9	3	.0
19			2	25	11	0	27	8	3	2	1.1
20			0	27	6	0	22	7	6	3	.0
Mean	72	328	1.85	22.45	10.55	0.3	25.26	7.47	5.55	2.6	.32

TABLE 13. Characters of the Plant of Early Caribbean

Plant No.	Days to Anthesis	Plant Height cm.	Length Husk Leaf Blades cm.	No. Primary Tassel Branches	No. Secondary Tassel Branches	No. Tertiary Tassel Branches	Length Central Spike cm.	Diameter Tassel Peduncle mm.	Tassel Exsertion cm.	Angle of Tassel Branches	Condensation
1			0	18	5	0	22	6	7	2	.0
2			0	20	6	0	21	6	10	1	.0
3			0	23	6	0	18	6	5	2	.0
4			0	20	4	0	22	5	10	2	.0
5			5	15	1	0	28	5	7	2	.0
6			10	20	7	0	24	6	8	1	.0
7			0	15	8	0	18	5	10	2	.0
8			0	14	2	0	24	4	6	2	.0
9			0	14	4	0	28	6	10	1	.0
10			6	18	6	0	27	5	4	2	.0
11			4	19	8	0	22	8	2	3	.0
12			3	17	3	0	29	6	2	2	.0
13			3	19	5	0	28	6	7	2	.0
14			3	17	7	0	27	5	3.5	2	.0
15			0	19	9	0	21	6	4	2	.0
16			0	12	3	0	28	6	5	2	.0
17			0	17	2	0	25	6	1	3	.0
18			0	18	3	0	23	5	0	2	.0
19			0	14	3	0	26	5	7	2	.0
20			0	19	7	0	25	5	5	2	.0
Mean	48	193	1.7	17.4	4.95	0.0	24.3	5.6	5.65	1.95	.0

TABLE 14. Characters of the Plant of St. Croix

Plant No.	*Days to Anthesis*	*Plant Height cm.*	*Length Husk Leaf Blades cm.*	*No. Primary Tassel Branches*	*No. Secondary Tassel Branches*	*No. Tertiary Tassel Branches*	*Length Central Spike cm.*	*Diameter Tassel Peduncle mm.*	*Tassel Exsertion cm.*	*Angle of Tassel Branches*	*Condensation*
1			5	22	9	0	25	8	3	2	.0
2			4	21	5	0	28	7.5	6	2	1.2
3			0	21	6	0	22	7	2	3	.0
4			3	16	11	0	26	7.5	5	2	1.4
5			0	16	5	0	29	6	0	2	.0
6			4	15	7	0	27	7	0	2	1.2
7			0	17	8	0	32	8	0	2	.0
8			1	13	4	0	27	6	6	2	.0
9			3	18	6	0	31	8	7	3	.0
10			4	16	5	0	23	7.5	0	3	.0
11			3	16	4	0	29	7	0	3	1.6
12			0	13	0	0	28	6	6	2	1.4
13			0	16	3	0	22	6.5	6	2	.0
14			0	11	2	0	29	7	4	2	1.4
15			0	19	3	0	23	6.5	4	2	.0
16			0	9	2	0	27	6	6	3	1.2
17			0	17	5	0	28	6.5	6	2	1.2
18			0	14	2	0	25	8	0	2	1.2
19			0	18	3	0	22	7	10	2	.0
20			3	12	2	0	broken	5	7	2	1.2
Mean	56	257	1.5	16.0	4.6	0.0	26.47	6.9	3.9	2.25	.65

TABLE 15. Characters of the Plant of Tusón

Plant No.	*Days to Anthesis*	*Plant Height cm.*	*Length Husk Leaf Blades cm.*	*No. Primary Tassel Branches*	*No. Secondary Tassel Branches*	*No. Tertiary Tassel Branches*	*Length Central Spike cm.*	*Diameter Tassel Peduncle mm.*	*Tassel Exsertion cm.*	*Angle of Tassel Branches*	*Conden-sation*
1			0	21	5	0	28	7	10	2	1.2
2			0	18	9	0	29	6	10	2	.0
3			0	25	3	0	30	7	0	1	1.2
4			0	25	7	0	19	6	2	3	.0
5			0	23	4	0	27	6.5	9	3	1.6
6			0	21	10	0	20	5	8	2	.0
7			2	19	5	0	31	8	0	2	.0
8			0	23	5	0	35	7	5	2	.0
9			0	22	10	0	27	6.5	14	2	.0
10			0	21	5	0	29	5.5	5	2	.0
11			0	24	5	0	32	8	6	3	1.6
12			0	16	6	0	28	8	9	2	1.7
13			0	17	7	0	25	6.5	6	2	.0
14			0	18	6	0	26	7	4	2	1.3
15			0	24	5	0	19	5.5	7	2	.0
16			0	24	4	0	22	6	7	2	.0
17			0	27	9	0	25	6	7	1	.0
18			0	21	3	0	27	5.5	6	2	.0
19			0	29	10	0	28	7	7	2	.0
20			0	31	11	0	27	8	0	2	1.5
Mean	62	298	0.1	22.45	6.45	0	26.7	6.6	6.1	2.05	.505

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