THE OXFORD HANDBOOK OF

CARIBBEAN ARCHAEOLOGY

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CHAPTER 27

HUMAN–PLANT DYNAMICS IN THE PRECOLONIAL ANTILLES

A SYNTHETIC UPDATE

JAIME R. PAGÁN-JIMÉNEZ

For nearly 30 years, paleoethnobotanical information on the interrelationships between past human societies of the Antilles and the plants that served to meet their food, medicinal, and ritual needs has been consistently pieced together (Berman and Pearsall 2008; Newsom and Wing 2004; Pagán-Jiménez 2009b). To some extent, such information has promoted renewed and more realistic visions about the Antillean precolonial ethnobotany. Although now data gathered for proposing new interpretations about different phytocultural dynamics comes directly from archaeobotanical remains recovered through archaeological studies, before the late 1980s interpretations on the botanic culture of the many cultural traditions relied essentially on early European chronicles (e.g., Colón 1992; Fernández de Oviedo y Valdés 1851; Las Casas 1909). This ethnohistoric information, coupled with a huge set of ethnographic data on those living cultures of the South American tropical forests, served to build a relatively unified precolonial ethnobotanical history within which agroeconomic developments and other related cultural changes were seen as progressive and linear processes. Considering the above, one might suggest that a phytocultural "meta-theory" exists in Antillean archaeology, which has been created and consistently maintained. This phytocultural meta-theory can be summarized as follows:

1. There was an early period of human mobility (ca. 7600 and 2100 B.P.), in which various pre-Arawak groups ("Archaic" period) depended solely on hunting, fishing, and the gathering of seeds, wild fruits, and tubers (Alegría, Nicholson, and Willey 1955; Allaire 1999; Chanlatte Baik and Narganes Storde 2002; Rouse 1992; Veloz 1978). These human groups, similar to continental hunter-gatherers, did not meet the technological requirements and the necessary cultural skills to establish strategies for producing useful plants. From an ethnobotanical point of view, they depended on the seasonal environmental changes and the plant resources provided by nature. The absence of pottery, usually associated with agricultural life in the Antillean precolonial world, was one of the main indicators for labeling such groups as simple gatherers of wild plants.
2. Near 2500 B.P., one or more waves of continental agroceramic people (Huecoid and Saladoid) entered the islands and displaced, or wiped out, the pre-Arawak groups. They introduced an exogenous horticultural production system and a toolkit complex (cibucán-guayo-burén) for processing vegetable foods. Manioc was the main botanical resource (Allaire 1999; Chanlatte Baik and Narganes Storde 2002; Rouse 1992; Wilson 2007). With that horticultural system, and slash and burn as the main technological component of it, plots were created for producing manioc as the staple food crop. Manioc was paramount because burenes (clay griddles) found on many archaeological sites from that times were used almost exclusively for cooking cassava bread. Said idea was supported by the ethnohistoric and ethnographic information used to define an almost exclusive relation between burenes and manioc. Other plant resources, such as sweet potato and cocoyam (*Xanthosoma* sp.), had to be introduced from the continent along with manioc during that early period of agroceramic immigration. In this context, a horticulture-based economy of roots and tubers has been considered to be one of the main agroeconomic production systems of the neotropics because it is nicely adapted to the ecosystem dynamics of the tropical forests. Their potential productivity should be variable, but it has been considered inferior to other production systems such as those of full agriculture because it is assumed that horticulture only produces a portion of the necessary food resources for people, coincident with considerable amounts of wild foods (Starke 1986).
3. Once established for several hundred years in the Antilles, the agroceramic Saladoid groups began to diversify around 1500–1400 B.P. as a consequence of their adaptation to the different environments, creating varied cultural traditions (Rouse 1992). Some theoretical premises argue that with the emergence of these new sociocultural formations, new

> plant production strategies were also developed (Newsom 1993; Veloz 1978). From "horticultural" societies, people directed plant production toward the creation of more efficient "agricultural" systems in order to sustain both a growing population, and the emerging hierarchical social structure that was initiated during this period. Between 1500 and 1000 B.P., the *cacicazgos* (chiefdoms) documented by the European chroniclers developed. It is believed that changes registered in plant production systems were aimed to maximize the productivity of some species, such as manioc, for creating surpluses (Newsom and Wing 2004). Among some of the technological changes associated with the transition between horticulture and agriculture, it was proposed, are the appearance of raised fields (agricultural mounds) and the subsequent incorporation of irrigation and terracing (Cassá 1974; Newsom and Wing 2004). Thus, during the Indo-Iberian contact period, the predominant and most important agroeconomic production system in the Greater Antilles was raised fields (montones), which produced large quantities of root plants such as manioc and sweet potato (Las Casas 1909; Rouse 1992). Although of minor relevance, maize has been identified as one of the food plants produced and consumed in a green state within these raised fields.

Without pretending to be exhaustive, I have outlined some of the major theoretical premises widely used as a template for explaining varied pythocultural dynamics, and agroeconomic subsistence strategies of the precolonial Antilles. Other theoretical models of great importance, although essentially attached to the phytocultural "meta-theory," dealt with particular agroeconomic themes of which two are central: (1) the study of production variability of horticultural systems (based on slash and burn) regarding ecological variability of the islands (Veloz 1978), and (2) the study of horticultural systems based on least-cost approaches derived from Optimal Foraging Theory (Keegan 1986). Both models were finely crafted and solidly supported by ecological data, and by human behavioral ecology templates rooted in premises of the formal economy. Above all, these models were highly dependant on the ethnohistory of the Antilles and on the ethnology of some indigenous peoples of the South American neotropics. Such models, however, were built without any support from archaeobotanical data that would allow us to corroborate or reject their main premises.

In this chapter, I discuss archaeobotanical data retrieved during the last decade, which contradicts the main premises of the "meta-theory." The synthetic exposition of new phytocultural scenarios proposed here is intended to stimulate new interpretive models and research on the paleoethnobotany of the Antilles. Two central issues will be addressed: (1) plant production and dispersals during the pre-Arawak era, and (2) the use of burenes for the processing and cooking of a broad suite of useful plants in later agroeconomies of the region in which manioc probably played a secondary role.

Early Human and Plant Dispersals Toward the Antilles (from ca. 7500–2500 b.p.)

Broader sets of pollen and phytolith data, together with ancient starch grains recovered in Central and northern South America has firmly established that the Antilles' surrounding continental region was an active territory of circulation for major economic plants such as maize, squash, manioc, and possibly other high-yield plants like the common bean (*Phaseolus* sp.), beginning at least 9000 years B.P. (Pagán-Jiménez 2011c; Piperno et al. 2009). Key research anchored on ancient starch grain analysis in southern Central America (Dickau, Ranere, and Cooke 2007; Piperno et al. 2000) has demonstrated the early movement of crops from north to south of the hemisphere and vice versa once they became domesticated during the Pleistocene–Holocene interface, between ca. 10000–9000 B.P. The starch grains of domesticates such as those mentioned above, originating in different areas to the north and south of the Panamanian Isthmus, have been confidently identified in Panama between 7800 and 5600 cal B.P. (Piperno and Holst 1998). This led Dickau et al. (2007) to argue that these plants moved independently from one another and from technological dispersals, like ceramics or metallurgy. Following this argument, crop dispersals occurred along land routes suggesting to these researchers that diffusion or exchange of plant germplasm among neighboring groups triggered this wave of spread, rather than by the migration of human populations importing their entire suite of domesticates.

However, concomitant to these processes of crop dispersals between north and south of the Tierra Firme (Gnecco and Aceituno 2004; Piperno et al. 2009), a unique event took place in the Americas: the first human reached the Antilles by around 7700 B.P. (Rodríguez Ramos et al., this volume). It was the peopling of one of the last unoccupied regions in this hemisphere and probably represented the longest maritime journey registered in this part of the world (Rodríguez Ramos 2010). Today it is acknowledged that this time of earliest human incursions into the Antilles was characterized by broader processes of intense human mobility and exchanges occurring along the entire surrounding continental area (Ranere and Lopez 2007), and plants certainly played a major role within these processes. In this context, answers to questions regarding why and under what subsistence conditions people moved into the Antilles, have never been articulated in a plausible manner (Rodríguez Ramos et al., this volume). Bearing in mind that the earliest human migrations to the Antilles occurred between 7700 and 7000 B.P., which is a period that nicely coincides with the anthropogenic "clustering" and creation of new dietary suites of domestic plants of diverse neotropical origin (Dickau, Ranere, and Cooke 2007), it is suggested that these new subsistence conditions could have encouraged or supported migration toward unpopulated regions such as the Antilles (see Keegan and Diamond 1987, for a similar argument, but for later migratory events to the Antilles). Plant dispersals along with human migrations can be interpreted as the transference of routinized daily practices (Bourdieu 1977), or the continuous presence of past cumulative experiences in new places (De Certeau 1984) for alleviating uncertainty (or increase predictability) and ensure comfort while trying to provide a preferred, previously constructed diet (Berman and Pearsall 2008; Pagán-Jiménez 2007; see also Petersen 1997).

But what data do we have in the Antilles to support such possible explanatory model for the earliest human transference of exogenous plants and what happened after? Puerto Rico has revealed a clear picture regarding these matters for its earliest phases of human occupation. Paleoecological studies carried out on the northern coast of Puerto Rico indicated a significant increase in fires (i.e., charcoal particulate), which began between 5500 and 3800 cal B.P. near the Laguna Tortuguero, possibly as the result of anthropogenic activities (Burney, Burney, and MacPhee 1994). Human groups in and around Angostura site in northern Puerto Rico were possibly exploiting resources in the area from around 6900 cal B.P., eventually settling Angostura between 4400 and 3800 cal B.P. (Pagán-Jiménez 2009a). These and/or other related groups are likely responsible for the changes observed in the paleo-fire sequences due to the possible development of slash and burn agricultural systems (Rodríguez Ramos and Pagán-Jiménez 2006; Figure 27.1). Likewise, on Vieques island (Sara et al. 2003) charcoal particulates increased drastically by around 2840 cal B.P. suggesting that pre-Arawak peoples were modifying substantially their floristic environment, perhaps for plant production purposes.

Paleoethnobotanical research on pre-Arawak sites of the region is limited to the northeastern Antilles. The earliest archaeological sites in which archaeobotanical data have been recovered are Maruca (4900–2700 cal B.P.), Puerto Ferro (4200–2600 cal B.P.) and Cueva Clara (4000–3500 cal B.P.) in Puerto Rico, and

Figure 27.1. [Modern *conuco* (agricultural plot) of maize, manioc, and other minor crops performed by previous slashing and burning of the forest. Distrito La Jaiba, Puerto Plata Province, Dominican Republic.]

Plum Piece (3700–3600 cal B.P.) in Saba. For all these cases a total of 43 lithic and coral artifacts have consistently revealed a suite of domestic and wild plants almost identical to those identified in the Isthmo-Colombian region, together with a lithic repertoire consisting of millingstone bases and edge-ground cobbles commonly found in southern Central America, northwestern South America, and the Antilles (Pagán-Jiménez 2009b; Rodríguez Ramos 2010). Different to the Panamanian case, the occupants of these four sites managed a whole suite of plants and lithic technology. This evidence clearly shows the early and variable presence, production and/or harvesting of exotic plants such as manioc, sweet potato, maize, arrowroot, common bean, and wild crops such as arrowhead (*Sagittaria lancifolia*) and bijao (*Renealmia* cf. *alpinia*), adding to the autochthonous Antillean marunguey or *Zamia* sp. (Pagán-Jiménez 2011c; Pagán-Jiménez et al. 2005), within anthropogenic scenarios insistently characterized as of hunter-gatherers-fishers (Fitzpatrick and Keegan 2007).

In terms of plant processing during pre-Arawak times, the majority of the ancient starch grains were recovered from lithic grinding/pounding artifacts such as irregular, conical, multifaceted pestles and edge-ground cobbles, as well as millingstone bases of different raw materials. Other artifacts related to previous or subsequent stages of plant processing have not been tested extensively (e.g., shell/lithic scrapers, possible lithic griddles, etc.). However, processing techniques of the various important plants suggest some interesting aspects of the possible cooking techniques used during these early stages of human penetration to the Antilles. Experimental studies of modern starch grains subjected to different types and degrees of processing has produced general scenarios for understanding ancient starch grain damaging (Henry, Hudson, and Piperno 2009; Pagán-Jiménez 2011a). Many of the starch grains recovered in the four pre-Arawak sites show clear signs of pressure on their surface resulting from the grinding/pounding of the plant source (seeds, tubers, etc.). This is the case of maize, marunguey, bean (domestic and wild), and sweet potato, among others. Other plant organs such as the tuberous stem of marunguey, the tubers of sweet potato, and seeds from bean were sometimes boiled before grinding/pounding, while in other instances seeds of maize were subjected to parching over a heat source. Finally maize, as well other seed and tuberous plants, were subjected to heavy grinding/pounding to a level that starches broke notably. The case of maize, in this sense, is revealing because this type of damage has been registered in modern maize seeds of hard endosperm that were subjected to grinding without previous soaking of the seeds.

Important differences have also been noted regarding the processing and use of wild plants at some of these early sites. Cueva Clara revealed starch grains of *Smilax coriacea* (sarsaparilla), which is a rhizomatous climbing plant pertaining to a genus widely used for medicinal remedies against arthritis, skin and venereal diseases, and fever, among others (Van Wyk and Wink 2005). Plum Piece revealed starches from two different plants of the Zingiberaceae family that could be used for either food or medicine. One of them, identified as *Renealmia* cf. *alpinia* (bijao) on a millingstone base, allowed inferring the maceration of its rhizomes for releasing its starches for food. Starch derived from the rhizomes of this genus has been used, along with the leaves used for wrapping, for preparing tamales in modern rural Central America (Bonta et al. 2006). The maceration of these rhizomes could be performed also for preparing the root to further uses such as an infusion or medicinal pastes. A different species of Zingiberaceae was also identified only to a family level, though the maceration of its rhizomes in the same millingstone of the *Renealmia*, together with the conical pestle in which the plant was also identified, could be suggesting the processing of the rhizomes for making foodstuffs. Annato (*Bixa orellana*) and marunguey (*Zamia* sp.) was also recovered in the same conical pestle at Plum Piece.

These results and their respective interpretations can be placed by now in a network of regional interactions in the northern Antilles and in a period oscillating between ca. 4800 to 2700 B.P. Northwestern Cuba, and probably that whole island, participated in this regional network as represented by the archaeobotanical data recently recovered in the Canímar site (^{14}C-dated to as early as 7600 cal B.P.), Matanzas province in Cuba, which revealed a similar set of domestic and some of the wild plants from contexts dated between 3300 and 2800 B.P. (Roberto Rodríguez Suárez, personal communication, 2008; Paz 2006). These new data strongly argue for the millenarian existence of multiple pan-Caribbean exchange networks built-up and maintained through time (Rodríguez Ramos and Pagán-Jiménez 2006). Important continental plants were clearly introduced from the mainland and later dispersed within many of the isles, while the eventual knowledge and use of local wild species such as *Zamia*, restricted today to the Greater Antilles, were integrated and dispersed in some of these early regional networks.

The recovery of macrobotanical remains belonging to some exotic arboreal taxa and some grasses, such as *Portulaca* sp., in other previously studied pre-Arawak sites of the Antilles (Newsom and Wing 2004), suggests the development of arboriculture and home gardens, and/or the creation of agricultural plots (i.e., slash and burn) whose disturbances stimulated the appearance of colonizing plants (Pagán-Jiménez 2002). The starch grain data obtained from Maruca, Puerto Ferro, Cueva Clara, and Plum Piece strengthens the results previously provided by other researchers that identified maize pollen and phytoliths in contexts dated to ca. 2790 and 3450 cal B.P. in northern Puerto Rico and the Dominican Republic, respectively (Newsom and Pearsall 2003; Sanoja 1989; Siegel et al. 2005).

Although archaeobotanical data collected up to now is not extensive enough to imply that these plants were the food staples, it is reasonable to conclude that the systematic production of some of them (with different intensities through time) was a fact from at least 4900 B.P. Various production systems should be applied for accessing the identified plants: (a) the "horticultural" way of producing and maintaining fruit trees and some tuberous plants such as arrowroot and sweet potato in partially forested plots (e.g., house gardens and/or *chagras*); (b) the "agricultural" way of producing plants such as manioc, maize, and beans in totally open (deforested) plots; and (c) the "gatherer" way of managing and collecting of wild plants such as marunguey, wild yam, wild bean, native ginger,

Figure 27.2. Harvesting of marunguey (or guáyiga) for making a kind of bread (*arepa*) in modern eastern Dominican Republic (photo courtesy of Dr. José R. Oliver).

and sarsaparilla in different ecosystems (Figure 27.2). These systems, rather than be production strategies that evolved from simple to complex (hunter/fisher/gatherer→horticulture→agriculture), need to be accepted as interconnected/joint systems that functioned with great variability within a single settlement, according to environmental and social factors. Thus, starch grain analysis of pre-Arawak contexts has shown that many of the plants identified up to now were not produced, gathered, and processed in an automated way. A diverse array of options were created and used for producing or procuring plants as exposed above, while a multifaceted ethnobotanical approach was also developed by those people for processing raw and cooked plant organs in the context of food (and perhaps medicinal) preparation and consumption.

Exogenous Agroceramic Expansion to the Antilles and Later Pythocultural Developments in the Region (ca. 2600–400 b.p.)

By around 2600 b.p., various exogenous cultural manifestations, which brought typically continental ceramic traditions and culinary practices, entered the islands from various areas of northern South America. Those societies, archaeologically known as Huecoid and Saladoid, have been traditionally characterized as tropical forest societies that originated in the tropical forest, where they supposedly developed slash and burn horticultural systems for producing manioc and other minor crops (Petersen 1997; Rouse 1992; Wilson 2007). According to deeply rooted beliefs, manioc was the staple crop for all of the agroceramic periods defined for the precolonial Antilles because burenes, which appeared for the first time with these people, attested to the production of cassava bread. So, interpretations about the production of manioc and its intensification through time are grounded in burenes, population growth, and the generally accepted understanding that these artifacts are directly associated to manioc production (Rouse 1992).

The starch grain analysis approach applied to lithic, coral, shell, and ceramic assemblages from the Antilles and northeastern South America has begun to reveal a clear picture regarding tool function and the plants, which were processed or cooked with them. However, I will go mainly on the buren aspect because this is the main "supporting evidence" for the current phytocultural meta-theory developed in our region for characterizing all the agroeconomic societies of the islands as manioc horticulturists.

Starch residues extracted from 19 burenes geographically distributed between Puerto Rico, Dominican Republic, and Cuba contradict preconceived notions regarding the cooking of vegetal foodstuffs. Late Saladoid contexts from Puerto Rico (King's Helmet and Ceiba-11 on the eastern coast and Arecibo-39 on the north coast), which date between 1400 to 800 cal B.P., revealed the processing and cooking of plants such as marunguey (two species), sweet potato, maize, beans (wild and domestic), and arrowroot on the analyzed burenes (Pagán-Jiménez 2008, 2011a, 2011b). Unfortunately, no burenes have been studied at earlier Saladoid and Huecoid contexts. Meillacoid contexts in the Dominican Republic (El Popi site in the Puerto Plata province), ascribed by relative chronology to contemporaneous contexts ranging between 1200 to 600 B.P., has evidenced the use of burenes for processing and cooking sweet potato, maize, and beans (domestic and possibly wild). Finally, other contemporaneous and later Ostionoid sites and contexts, such as El Cabo and Edilio Cruz (1200 to 500 B.P.) in eastern and northern Dominican Republic, respectively, Macambo II and Laguna de Limones (950–600 B.P.) in eastern Cuba, and Ceiba-33 (700–630 cal B.P.) in eastern Puerto Rico, have pointed out the use of burenes for processing and cooking marunguey (guáyiga in the Dominican Republic), sweet potato, maize, bean, arrowroot, as well as cocoyam and annatto in one case each. So far, starch grain analysis has demonstrated that the buren, previously exclusively associated with the cooking of manioc bread (Rouse 1992), was used for processing and cooking a broader spectrum of plants (Pagán-Jiménez 2009b).

It is now known that the introduction of manioc to the northern Antilles dates to the pre-Arawak era, based on starch grains recovered on grinding stone artifacts from Maruca, Puerto Ferro and Cueva Clara (Pagán-Jiménez 2011c). Although considered a staple of the diet in the precolonial Antilles and northeastern South America through all the agroceramic periods, the presence of manioc is extremely minimal in samples studied to date. Moreover, a limited number of stone grater board teeth, traditionally associated with manioc processing in the Antilles and the South American neotropics, have also been studied and no manioc starch has been found, thus replicating results derived from similar studies performed in the Bahamas and the upper Orinoco (Berman and Pearsall 2008; Perry 2005; Rodríguez Ramos and Pagán-Jiménez 2006). Ancient manioc starches have been documented in 18 (9.3 percent) of 198 tools and human teeth sampled so far from the Antilles and French Guiana (Mickleburgh and Pagán-Jiménez 2012; Pagán-Jiménez 2011c). All of these positive identifications correspond with artifacts used for pounding or grinding (manos and mortars of stone or coral) by the pre-Arawak and Huecoid, and with a similar set of artifacts of the early and late Ostionoid peoples where manioc starches were also recovered in a ceramic cooking bowl (Pagán-Jiménez 2011c).

Looking to mainland South America, French Guiana is one of the best scenarios for testing the buren/manioc association because this region was embedded in one of the more notorious interaction spheres of northeastern South America during precolonial times (Boomert 2000; Lathrap and Oliver 1987). This interaction sphere geographically encompasses not only the coastal areas to the north but also the inland areas to the east and south facing the northeastern frontier of the Amazonia. It has been generally acknowledged as one of the main cultural epicenters for the dispersal of manioc, its derived horticultural economies and its culinary culture (Perry 2005). Burenes from Early Ceramic to late Neoindian sites in French Guiana (2100–300 B.P.) exhibit an interesting pattern of plant processing and cooking. Among them, a broad suite of useful plants has been identified by its starches: chili pepper (a domestic species), sweet potato, maize, bean, manioc, different species of Marantaceae (arrowroot), and unidentified palm fruits. Overall results on these "manioc" diagnostic artifacts showed that maize and sweet potato are the more ubiquitous plants, while manioc starches were only recovered on one buren from the Neoindian site of PK-11. Beyond burenes, manioc starches were identified also in two serving bowls related to later episodes of human occupation of the Early Ceramic site of Chemin Saint-Louis (1950–1600 B.P.) and in a cooking bowl of the late Neoindian site of SAC-2. Interestingly, parallel starch grain analysis conducted at the late Neoindian site of Sable Blanc (ca. 1000–800 cal B.P.) in French Guiana (McKey et al. 2010) has demonstrated the processing and cooking of manioc in three of the four selected burenes, although maize registered the highest ubiquity in all these artifacts ascribed to the Barbakoeba culture of the Arauquinoid cultural tradition.

Concluding Remarks

Information discussed above clashes dramatically with the phytocultural "meta-theory" still in vogue within Antillean precolonial archaeology. It is now acknowledged that pre-Arawak societies dispersed domestic plants to the isles at different points in time. At least some of these early human groups were developing varied strategies for producing and gathering plants by around 4900 B.P. The processing and probable consumption of plants during this early stage of human occupation points to a pan-Caribbean exchange network of goods, ideas, and phytocultural practices in view of the similarities observed between tool assemblages and plants among distant areas such as the Isthmo-Colombian region and the northern Antilles (Rodríguez Ramos et al. this volume).

The later arrival of South American agroceramic groups, and their subsequent evolution together with the pre-Arawak peoples that preceded them, and others including Barrancoid and Arauquinoid groups actively engaged in a pan-Caribbean exchange circuit, show that plants played an important role in the emergence of new local and regional identities. These peoples also dispersed a new tool complex for processing and cooking foodstuffs, but interestingly manioc was not the paramount staple crop at this time, or near the end of the precolonial era. Instead, a varied assemblage of important botanic resources were integrated into dynamic cultural scenarios from which new pictures are now revealing unique and sometimes contrasting botanic cultures interacting together in space and time. Following current paleoethnobotanical perspectives on the Antilles and French Guiana, it is clear that the buren has shown so far that manioc may not have been important prior to the Indo-Iberian period. During precolonial times, the northern Antilles adopted and exploited high-yield wild plants such as marunguey in combination with other domesticates and cultivars (Figure 27.3). Burenes in that region were clearly used for processing and cooking foodstuffs derived from a variety of plants. In fact, paleoethnobotanical information gathered to this date for precolonial Puerto Rico affirm that marunguey, together with maize, sweet potato, arrowroot, bean (wild and domestic), and yellow sapote (*Pouteria campechianum*) were the most ubiquitous, while manioc, achira (*Canna* sp.), yam (wild and domestic *Dioscorea/Rajania*), cocoyam (*Xanthosoma* sp.), and jack bean (*Canavalia* sp.), among others, played a secondary but consistent role in diet (Pagán-Jiménez 2011a). It is believed that something similar occurred in precolonial French Guiana because maize has been registered widely over manioc in the studied burenes and other plant-processing artifacts perceptible suggesting some kind of differentiation between diverse botanic cultures or between a varied span of culinary identities (Pagán-Jiménez 2007, 2011c).

It is important to note that distinct from other archaeobotanical techniques, starch grain analysis makes possible the direct association between artifacts and the rich starchy plants processed, stored, or cooked with them (Pearsall et al. 2004; Pagán-Jiménez 2011b). But following this, it is plausible to raise the question that some food plants within the overall available botanical repertoire could remain unregistered if their starchy organs were not treated with the type of tools studied up to now. Hence, complementary studies based on human bone isotope and starch grain analysis in dental calculus could bring to light the consumption of foods that were not prepared on the artifacts studied. Recent research, using human bone isotope analysis to reconstruct paleodiet in a broad sample of

Figure 27.3. Modern small raised fields in the rural Municipality of Yabucoa, Puerto Rico, for producing mixing crops such as manioc, maize, bean, and yam.

270 human individuals, ranging chronologically between 1700 and 500 cal B.P. in Puerto Rico (Pestle 2010, this volume), established the consistent importance of C_4 (e.g., maize) or CAM plants for all the studied periods and archaeological sites (the late Saladoid site of Punta Candelero, and the multicomponent sites of Paso del Indio and Tibes). This new and highly detailed study, in the general context of precolonial Puerto Rico, resembles previous starch grain results obtained in archaeological artifacts (Pagán-Jiménez 2011a). Moreover, recent preliminary results on starch grain analysis applied to dental calculus in 30 human individuals of precolonial origin has shown, for the periods (ca. 2000–500 B.P.), including burials from Trinidad, Aruba, Guadeloupe, Saint Lucia, Saint Vincent, Saint Thomas, Puerto Rico, and the Dominican Republic, that maize was one of the most important food plants (Mickleburgh and Pagán-Jiménez 2012). Bone isotope and dental calculus analysis have registered smooth changes and temporal fluctuations in the ranking of important food plants when contextual scales are reduced to a site, microregion, or island level of analysis. In Puerto Rico and the Dominican Republic, for example, starch grain analysis performed on artifacts has shown that maize and marunguey switched constantly the highest ranking position among food plants across time.

Maize has been commonly considered a late introduction into the precolonial Antilles (Rouse 1992; Wilson 2007), or as a late high-yield plant source used in northeastern South America, including French Guiana (Pearsall 1994). Maize has also been consistently interpreted (Newsom 2006; Newsom and Wing 2004) as an almost exclusive food item for the indigenous elites in later periods and, in consequence, as a plant of minor importance for the overall precolonial diet of the islands in any period. Recent paleoethnobotanical data from Cuba, Bahamas, Hispaniola, Puerto Rico, and some of the Lesser Antilles (Berman and Pearsall 2008; Pagán-Jiménez 2011a), together with recent results derived from isotope analysis (Pestle 2010) and dental calculus analysis (Mickleburgh and Pagán-Jiménez 2012), has demonstrated the importance of maize, ranging from domestic/communal to ritual/magic-religious spaces and artifacts of many of the periods defined for the northern Antilles and French Guiana, which contrast heavily with previous restrictive assumptions assigned to this plant.

Caribbean archaeologists have long assumed that ethnographic and ethnohistoric accounts provide an accurate portrait of precolonial plant use in the Caribbean. Starch grain analysis and related techniques are demonstrating that the use of plants was far more complex than previously recognized.

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