DISEASES OF MAIZE IN THE WET LOWLAND TROPICS AND THE COLLAPSE OF THE CLASSIC MAYA CIVILIZATION

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The Classic Maya civilization was centered in lowlands of the Petén in northern Guatemala, and collapsed mysteriously in the ninth century AD. Abandoned were rich agricultural lands carved without metal tools out of a tropical rain forest, lands that had been farmed with increasing intensity for six to sixteen centuries. The Maya evidently resettled in highlands to the south or in less productive dry lowlands to the north. No reoccupation occurred of the Petén farms, homes or ceremonial centers until their discovery in the past two centuries.

Sustained crop failure of maize (Zea mays L.) due to an epidemic of the plant-hopper-borne virus, maize mosaic virus (MMV), is proposed as a primary contributing cause of the collapse. Major diseases and pests of maize in the tropics are assessed for their relative significance in and near the Petén vs. the highlands, and the viruses are highlighted.

Maize mosaic virus is a devastating virus disease transmitted by the corn plant-hopper, Perlopinus maidis, an insect restricted to tropic lowlands. Maize and teosinte are its only definitively known hosts. Thus the disease has been serious only where maize is grown more-or-less continuously through the year in wet or irrigated tropics (e.g., Caribbean Islands, Venezuela, Hawaii, Tanzania, Australia). It is reported here for southern Mexico and the Petén of Guatemala. Resistance in maize occurs only in one known form, the gene Mv, that confers a high level resistance but not immunity. Resistance data are presented for 63 of the 67 races of maize thought to have evolved in the Northern Hemisphere. The Mv gene is shown to occur in all seven of the races of maize evolved in the Caribbean, but in none of the primitive Mexican or Central American races.

It is proposed that maize mosaic virus originated in northern South America at or about the time maize was brought into the Caribbean by the Arawak around the time of Christ. The sympatric origin or selection in maize of the Mv resistance mutant in this region is assumed to have led to its incorporation in all seven Caribbean maize races. It is conjectured that viruliferous leafhoppers were blown from the Caribbean into the Petén around the eighth century allowing the disease to become epidemic in susceptible maize races such as Nal-Tel and Tepecintle, grown by the Petén Maya. Sustained failure of maize production due to MMV would have characterized areas of intensive maize cultivation, particularly where it was year-round. The disease would have been less severe in areas with a long dry season, as to the north of Yucatán and it would not have occurred in the highland areas to the south and west, areas to which surviving Maya presumably migrated.

The Classic period of the Maya culture is dated between 300 and 900 AD, when it came to an abrupt close. The collapse has been the subject of extended inquiry and of a thorough treatise by anthropologists and archaeologists (Culbert, 1973). Although many potential causes have been cited, no concensus has been reached on the basis for the collapse. Among causes virtually excluded are those of foreign invasion, sustained drought or holocaust, human disease epidemic and socioeconomic decadence. The Maya collapse involved the abandonment of rich agricultural lands farmed as much as 1,000 years. They had been carved tediously out of lush rain forests, and probably managed with a degree of intensity previously considered impossible or unnecessary (Turner, 1974; Matheny, 1976; Siemens & Puleston, 1972). The desertion of these farmlands, to an agriculturist, must be
considered even more puzzling than the abandonment of houses and ceremonial centers. It is difficult to imagine a type of peasant revolution so disastrous as to cause complete abandonment of such fine lands, with no subsequent use by victors or passersby.

Sustained failure of a widespread staple crop like maize or rice due to diseases or pests must be considered a major factor in any agricultural abandonment. Those of the Maya (900 AD), Anasazi Cliff Dwellers (1300 AD) and Khmer (1400 AD) appear to bear similarity in this respect. One of the greatest calamities caused by plant diseases occurred in modern times (1845), when the downy mildew of potatoes called 'late blight' (Phytophthora infestans) accounted for the death or migration of half the four million people of Ireland, with tragic repercussions throughout Western Europe. It is the intent of this paper to examine the role that diseases and pests of maize, and the maize mosaic virus (MMV) in particular, might have played in the Classic Maya collapse.

The Classic Maya civilization occupied a total area little over 300 km × 600 km in what now includes southern Mexico, northern Guatemala, Belize and western Honduras (Fig. 1). It supported a maximum estimated population of two to three million people in three major regions—a southern montane area, a central region of lowland wet forests, and a northern region of drier lowland plains. Major Classic period centers were concentrated in the central region (Coe, 1966; Culbert, 1973).

The montane Southern Region (Fig. 1) probably served as the ancestral home of the Maya, where they can be dated lexicographically as early as 2500 BC. Initially nomadic hunters, they are thought to have turned to the cultivation of maize in the second millenium BC, perhaps as the result of the evolution and selection of lowland races of maize. Cobs of a lowland race of maize grown by the Maya, Nal-Tel, have been dated as early as 2450 BC from caves of Tamaulipas in northern Mexico, and as early as 1000 BC from Salinas la Blanca (Cuadros Phase) in southern Guatemala. Significant cultivation of maize developed in the first millenium BC in the highlands of central Mexico and Guatemala, but involved montane maize races distinct from lowland types. Pre-classic Maya settlements such as Izapa occur at lower elevations on Mexico’s dry southwest coast, and show some links to early Olmec centers of eastern lowlands. The middle Formative expansion of the Maya occurred at higher elevations between 800 BC and 300 BC, and later showed influence by the Teotihuacán cultures of highland Mexico. Post-classic centers like Iximché also occurred at high elevations. The highlands have a prevailing cool climate with prolonged winter dry season, and only a single long-season crop of maize is possible. Corn farming of the Maya highlands was probably dominated in the past as it is today by long-term culture of slash-and-burn or milpa farms, growing corn for periods of five to ten years followed by very long fallow periods, presently averaging 20 years (Ruthenberg, 1971).

The Central Maya region includes lowland areas north of the volcanic backbone of the Guatemalan and Chiapas highlands (Fig. 1). It is largely a tropical rain forest predominantly under 300 m elevation on flat, limestone-derived soils centered about the Petén region of northern Guatemala. The lush Central region is very sparsely populated today, although it once supported the major ceremonial centers of the Classic Maya such as Tikal, Uaxactún, Becan, Xunantunich, Bonampak and Palenque. Although the soils are very diverse, the predominant ones are black mollisols (rendolls) that are rich in organic matter, with water-logged vertisols often occupying the bajos or periodic swamps (Olson, 1978). The climax forest is dominated today by the chicle or zapote (Achras zapota) with canopy to height of 40 m, but comprises several hundred other tree species (Lundell,