Evolution, Domestication and Agrobiodiversity of Cassava in Brazil

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Evolutionary biology has many practical applications, such as design of vaccines to prevent influenza, identification of emerging pathogens such as the SARS virus, and prediction of pathogen resistance to drugs and insecticides. Less well appreciated, but just as significant, are the insights evolutionary biology can provide for agriculture. Plant domestication is an evolutionary process. When humans first began to grow plants, they cultivated species that were growing wild in the vicinity of their dwellings. Soon these first farmers began to collect seed, storage roots and tubers, and started to grow plants in field plots. Farmers saved seeds and propagating stalks from the individual plants that exhibited traits that were the most desirable, either for taste or for ease of cultivation. This process of 'artificial selection' leads to evolutionary change in crops much as natural selection acts in wild species. Domesticated plants have undergone many morphological and genetic changes from their wild ancestors, based on the artificial selection that was practiced first unintentionally by ancient framers, and then intentionally by plant breeders. Domestication traits that enhance farming include loss of seed dormancy, loss of seed shattering (dropping of seeds when ripe), loss of dispersal mechanisms (such as the long, fur-catching 'awns' on wild rice grains), loss of flower and seed set in the case of vegetative propagated crop like cassava, and loss of photoperiod requirements for flowering. Plant traits that have changed during the course of domestication include larger seeds, improved taste, varied color, and ease of processing. In fact, some crops have changed so much from their wild ancestor that it has been difficult to determine which wild species gave rise to the domesticated species. For example, the origin of corn was vigorously debated into the 1980s; it was only after DNA analysis that most people agreed that the Mexican wild species, teosinte, was the ancestor. Similar situation is taking place with cassava (*Manihot esculenta* Crantz) started with the work of Antonio Costa Allem in the 80's and continued with our own work in the latter 90's.

Understanding the process of domestication may lead to important insights to a pre-breeding research program to benefit agriculture and the development of new crop varieties. For instance we recognize that the process of domestication often involves a genetic bottleneck that leads to an overall reduction in genetic variation in the crop. We also know that the process of domestication is a continuum and that genetic diversity is not lost all at once. We expect that crop landraces — traditional varieties developed by local farmers — should have more genetic variation than the 'elite', high-yield varieties developed for modern agriculture. In this presentation we will illustrate some of these principles with our own research on cassava. Specifically we will discuss the geographical distribution of *Manihot* species and recognition of cassava site of origin based on DNA technology, identification of cassava closely related species and suggests the ancestor species of cassava based on molecular genetic analysis, and finally show how agrobiodiversity can be used to generate a genomic-based biotechnology that might impacts bioenergy efficiency and sustainability, as well as root nutritive quality throughout an innovating breeding program.