Tropical Maize and Lipid Cane As Sustainable Bioenergy Crops

Vijay Singh
University of Illinois

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What is Tropical Maize?

- Tropical Maize is Corn
  - Reproductive Asynchrony
  - Tropical Maize = Tropical x Temperate Maize Hybrid
- High Biomass
- High Stalk Sugars
- Less Nitrogen requirement
Teosinte (Zea mays ssp. parviglumis) appears now to be
the most widely agreed-upon candidate for the ancestor
of domesticated maize (Z. mays spp. mays), but there
are, at best, only partial answers to questions of how,
when, and where this process took place (Wilkes 1967,
1985; Beadle 1980; Iltis 1972, 2000; Matsuoka et al.
2002). In a break with conventional wisdom, Hugh H.
Iltis (2000:36 and quoted in Crosswhite 1982) has re-
cently suggested that the direct ancestor of maize "was
initially domesticated not for its grain but for its sugary
pith or other edible parts." We elaborate on his sugges-
tion by proposing that during Zea's initial period of do-
mestication the stalk provided a key source of sugar for
many uses, including the making of alcoholic beverages.
Furthermore, we suggest that the social importance of
Nutrient Use Efficiency

- TM produces more biomass and more sugar than commercial corn hybrids with < 50% N fertilizer requirement
US Sweetener Industry
Preparing the syrup by using a press

HPLC profile of the tropical maize syrup. Three main sugars content—Sucrose, Glucose and Fructose

Tropical Maize

Tropical Maize

Conventional Sugarcane Ethanol Process

- Cane
- Process Water
- Crushing
- Extracted Juice
- Bagasse
- Fermentation
- CO₂
- Yeast
- Stripping/Rectifying Columns
- Ethanol
- Mole Sieves
- Overhead Product (Recycled Back)
- Process Water
- Vinassee
- Centrifuge
- Concentrated Vinassee
- Evaporator
Tropical Maize

- Tropical maize requires few crop inputs such as nitrogen fertilizer, chiefly because it does not produce any ears.
- Require less processing than corn grain, corn stover, switchgrass, miscanthus.
- 25 percent or more sugar -- mostly sucrose, fructose and glucose
  - Easily fermented to ethanol
- Can be used in sugarcane to ethanol plant during the Inter-harvest
Lipid Producing Sugarcane (Lipid Cane)
Make World’s Most Productive Sugar Crop as the Oil Crop

- Plants already naturally produce oil
  - Use it as part of their metabolism
- By up-regulating the genes that make oil and down-regulate the genes that use it
  - Oil is stored in stems
- Currently we have achieved lipid cane with 2% oil (dry basis)
- Goal is to achieve 20% oil (dry basis) in Lipid cane
Accumulate Oil in Sugarcane

- Increase Photosynthesis
- Increase Cold Tolerance
Techno-Economic Analysis of Lipid Cane with Different Lipid Content

- Lipid cane techno-economic models were developed and compared with the current existing soybean and corn processing plants
- Lipid cane process model with lipid content of 0%, 2%, 5%, 10% and 20%
- Soybean-biodiesel process model with solvent (hexane) exaction
- Corn-ethanol process model with oil extraction from thin stillage
Lipid Cane

- Sugarcane producing lipids
- 2% lipid in stems, higher photosynthesis efficiency and improved cold tolerance
  - Goal – 20% oil in stems, 50% improvement in phytosynthesis
- Grown in land not used for food or other crops and can produce 40 billion gallons of biodiesel in the US
Thanks!