Cassava
Manihot esculenta

Source: http://gene3.ciat.cgiar.org/mascas/ and http://edge.rit.edu/content/P07403/public/Home

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Introduction

- Fun facts
- History
- Taxonomy
- Production
Fun facts

• Cassava originated in Brazil and Paraguay
• Domesticated approximately 10’000BP
• Toxic, many cyanogenic glucosides
  – Linamarin
  – Lotaustralatin
• Roots contain 30% starch; nearing the known physical limit for starch storage
Cassava Distribution Worldwide

Source: http://www.croptrust.org/documents/newsletter/magnified_map.htm
Taxonomy

- *M. esculenta* Crantz sp. *esculenta* is the only species in *Manihot sp.* to be cultivated

- 2n=36, however, other ploidy levels have been created in laboratories

- There are other varieties of *Manihot sp.* found in the wild which create viable offspring, but are not currently being cultivated
History

- Cassava was a staple food for South American and West Indies natives
- In the 17th century Cassava was brought to Africa with the slave trade
- It flourished as a reliable food source for the poor and soon spread to other parts of the world
Production

- 2006 production is estimated at 226 million tonnes and 2007 production is estimated at 228 million tonnes worldwide production.

Phenology

- Seeds
- Seedling
- Beginning of Leaf Stage
- Flowering Stage
- Leaves Developed
- Translocation From Leaves to Roots
- Maturity
Seeds

- Up to 12 mm long
- Cassava is generally planted as a cutting because seed germination is less than 50 percent.

Source: FAO
Seedling

• 5-7 DAP (Days after Planting) Adventitious roots emerge
• 10-12 DAP First leaves emerge
Beginning of Leaf and Root Systems

• 30 DAP True leaves start to expand. Photosynthetic processes starts to become positive.

• The leaves are dark green on top and pale green underneath. Leaves can have 3-9 lobes.

• Fiberous roots start to grow.
Flowering Stage

• Switches to reproductive stage around the time of first branching. The main stem can branch 2, 3, or 4 times, each producing their own branches.

• Indeterminate flowering
Flowering

- Monoecious: pistil and stamen flowers.
- The female (staminate) flowers open 1-2 weeks before the male flowers.

Leaves Developed

- 90-180 DAP the maximum growth rates of the leaves and stems occur.
- 4-8 of the fiberous roots thicken into storage roots.
- Above ground structure is fixed.
Translocation to Roots

• 180-300 DAP Photoassimilate partitioning from the leaves to the roots is accelerated. This causes increase in DM of the stem and roots and a decrease in DM or senescing of leaves.
Fig. 5.3. Growth of cassava plant during the first cycle (12 months). Average of two varieties. DAP, days after planting. Graph made from data of Lorenzi (1978).

Source: Alfredo Augusto Cunha Alves
Maturity

- About 8 months from planting
- Harvest a long tapered root that is 5-10cm in diameter and 50-80cm long

- Yield is approximately 10-15 tonnes/ha dry root yield and 30-40 tonnes/ha fresh root yield after 8 months.
- Yield continues to grow with more time, but at a slower rate.
- Final plant height is about 200-350cm tall.
Leaf Area Index

• Average LAI of 1-2 over growing period
• Very low in first and last 3 months of cultivation
• Leads to very little dry matter accumulation early and late in the growing period
• LAI is known to range from 1-7! (Although very rare, can be found in subtropic areas)
• Excessively high LAI can adversely affect DMA within the tuber
• LAI of 3-4 is optimal in the tropics
• The peak of LAI is between 4-6 months after planting at which point leaves die back
• Second bulking phase will not have as high a LAI as the first
• LAI is directly proportional to CGR until a LAI of 4
Crop Growth Rate

- Exponential, Linear, Levelling Off

**Fig. 5.3.** Growth of cassava plant during the first cycle (12 months). Average of two varieties. DAP, days after planting. Graph made from data of Lorenzi (1978).
• Cassava foliage and storage roots grow at the same time resulting in competition for assimilates.
Yield

\[ Ye = \int (Q \times I_{A'} \times \epsilon \times \rho) \, dt \]
\[ Ye = \int (20 \times 0.57 \times 0.75 \times 0.65) \times 365 \]
\[ = 2028.5 \text{g m}^{-2} \]
\[ = 20,285 \text{kg ha}^{-1} \]

- Approximately 20t ha\(^{-1}\) fits well with recorded Cassava yields under ideal circumstances.
True Yields

• In reality, Cassava yields are very low, achieving a yield only 20% of what it would be under optimal conditions

• Some reasons for these very low yields include pests, disease, droughts, poor cultivars,

• Actual yields
Effect of leaf temperature on net photosynthetic rate
Net Leaf photosynthesis response to PPFD
Future Outlooks

• Where to Improve Genetically
• Tolerance to stress
• Breed for Larger roots
• Functional Stay Green
• Breed for a Plant resistant to PPD
• To improve yields culturally

• Fertilizer
• Pesticides
• Irrigation
• Big Company Research Money
Cassava Consumption

• 2/3’s of the Cassava produced is used for human consumption, the remainder for animal feed
• Excellent source of vitamin C and to promote weight gain
• Nutrition content is on average approx.:  
  – Sugar; 4%  
  – Starch; 65%  
  – Protein; 31%
• Malnutrition is the most common cause of death in 3rd world countries
• Protein deficiency common leads to Kwashiorkor’s or Oedema
Cyanogenic glucosides

- Varies in cultivar and growing conditions
  - Sweet Cassava 40-130ppm
  - Non-Bitter Cassava 30-180ppm
  - Bitter Cassava 80-412ppm
  - Very Bitter Cassava 280-490ppm

- Concentrations <50ppm are safe
- However there is a risk of chronic cyanide toxicity (toxicity is often associated with malnutrition)

- Cultural practices in place to reduce concentration
• Aimed at improving this important food source
• Cassava is the 3rd most important source of calories next to rice and corn in the tropics
References


