

Tools for Fruit Tree Management

Luke 13:6-8

Then he told this parable: "A man had a fig tree, planted in his vineyard, and he went to look for fruit on it, but did not find any. So he said to the man who took care of the vineyard, 'For three years now I've been coming to look for fruit on this fig tree and haven't found any. Cut it down! Why should it use up the soil?' 'Sir,' the man replied, 'leave it alone for one more year, and I'll dig around it and fertilize it. If it bears fruit next year, fine! If not, then cut it down.'"

Abstract: *Fruit Tree Management*

This workshop will explore the impact of growth habit and seasonality on fruit production and tree management. Walk through the ECHO's arboretum and learn how to apply these principles to various types of trees.

Goal of this workshop:

To understand the tree's seasonal cycle and the processes, seen and unseen, that are occurring, over time, to better manage the tree and increase production.

Starter questions for delegates?

- Is anyone working with fruits?
- What types?
- What are you currently doing to manage your trees?
 - Irrigation practices?
 - Fertilization?
 - Pruning?

Some questions that we hope to answer in this workshop:

1. What could be a useful way to classify tropical and subtropical fruit trees?
2. What are different ways you can classify trees?
3. How do you make management decisions about your trees?

I. Phenology WHAT IS PHENOLOGY? HOW DOES IT RELATE TO FRUIT PRODUCTION?

1. Phenology - the study of recurring cycles and processes, seen and unseen, that are occurring in relation to climate and seasonal change.. In our case, we're talking about trees
2. Understanding timing, seasons and phenology--applies to migrations, etc...
 - a. Phenology of the tree
 - i. when does vegetative growth occur?
 - ii. when does root growth occur?
 - iii. when does flowering occur?
 - iv. when does fruiting occur?
 - b. Seasonality of your location
 - i. when is the growing season?

- ii. does it get cold, how significant is that cold?
 - iii.
 - iv. when is it dry?
 - v. what factors influence your trees?
- c. Example
 - i. Draw a phenology graph of Banana
 - ii. Draw a phenology graph of Mango
- d. Conclusion - in the same environment, with the same environmental stimuli, processes in these two trees differ by a lot. What causes these differences? What classification system would make sense of these differences?

II. Classification based on growth habit HOW DO WE CLASSIFY FRUIT BEARING TREES/PLANTS?

single stemmed, branched stem, fruiting location, shade, sun, size, drought tolerance, etc.....

3. Single Stemmed species

Very productive, predictable yield. Widely adaptable, short juvenile period

- a. Vegetative growth culminating in fruiting: **Banana**
 - i. pineapple, sisal
 - ii. first 4 months determine the size of the bunch and the number of hands
 - iii. growth will slow down in temperatures under 60 F, stops at 50 F
 - iv. Do best with nonlimiting soil moisture, nonlimiting nutrients and warm temperatures
- b. Vegetative growth and reproductive growth occurring simultaneously: **Papaya**
 - i. passionfruit, oilpalm, coconut
 - ii. Flower and fruit best with warm temperatures and where soil moisture is nonlimiting
 - iii. 3-4 months until first flowers
- c. Management implications:
 - i. Manage for continuous growth
 - ii. ideal conditions improve vegetative growth and therefore fruit production
 - iii. extreme conditions will cause adverse effects
 - iv. deficiencies will decrease, stop or delay fruit production
 - v. fertilizer and water applications can be frequent and regular
- d. Look at climate of origin for clues on how to manage trees
- e. Story or personal example

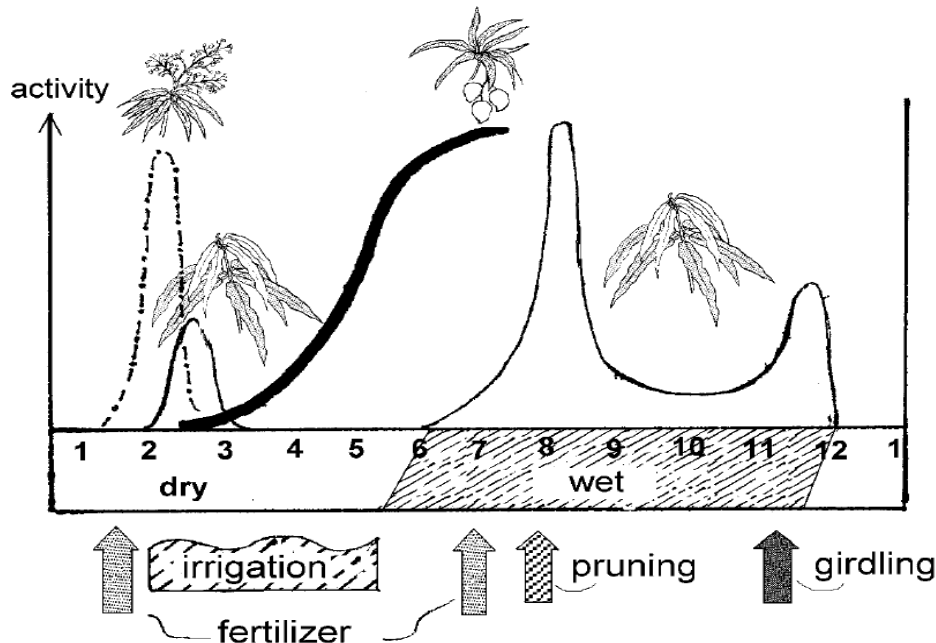
4. Branched species

erratic, unpredictable yields; long juvenile period

- a. Vegetative growth and reproductive growth occurring at the same time: (mainly small trees, shrubs and vines.) Ex: Passionfruit, strawberry tree,
- b. Vegetative growth and reproductive growth separated in time: **Mango**
 - i. lychee, longan, avocado, sapodilla, rambutan
 - ii. Mango grows from the tips, flowers from the tips
 - iii. Cold and/or dry conditions stimulate flowering after sufficient aging of the

last flush

1. mango in the subtropics
2. mango in the tropics (aseasonal climate)
- iv. flowering can occur after a period of stem rest (induced by drought)



Mango Management Operations in a Monsoon Climate (Agrodok 5)

- c. Vegetative and reproductive growth occurring simultaneously: **Carambola**
 - i. Orange, oilpalm, guava, passionfruit, breadfruit, coffee, macadamia, cacao, jaboticaba, durian, jackfruit
 - ii. are separated by location - flowering occurs off of older growth
 - iii. Carambola in particular:
 1. somewhat daylength sensitive
 2. wind protection
 - iv. Conditions that favor vegetative growth will also favor fruiting
 1. low temperatures and low rainfall slow production down.
 2. Examples of annona, guava (aseasonal)
 3. conditions that promote growth also promote flowering and fruiting
- d. Management implications
 - i. Alternating root and shoot growth - a more complex system of balancing vegetative and reproductive growth
 - ii. Flowering and Fruiting
 1. Cold and drought trigger flowering and fruiting: Mango, lychee, avocado [flowering separated in time]
 - a. these conditions are not the enemy, but are important in

management

2. Cold and drought limit flowering and fruiting: carambola, jackfruit, jaboticaba, guava [flowering separated by location]
 - a. designed for a climate with ideal conditions

iii. Fertilization

1. Fertilizing can promote vegetative growth at the expense of reproductive growth if applied at the wrong time [flowering separated in time]
 - a. Do you fertilize your mangoes? Will fertilizing your mangoes actually give you more fruit? It might actually give you less!
2. Fertilizing is necessary for heavy, asynchronous flowering and fruiting plants to maintain health [flowering separated by location]

iv. Pruning -

1. know the effect pruning has on your tree -
2. pruning too close to time of flowering can prevent flowering (mango, lychee)
3. pruning can promote flowering in carambola, guava, annona
4. Pruning can synchronize production

5. Practical Management Techniques for manipulating fruiting by influencing growth rhythm.

a. General:

- i. Reinforcing stress of dry season to prevent flushing
 1. Root pruning
 2. Removal of the topsoil under the tree
 3. Pouring salty water in a shallow ditch surrounding the tree.
 4. Raking away mulch from under the tree
- ii. Interrupting irrigation for 5-10 weeks will stop vegetative growth
 1. Only works if irrigation is practiced...
 2. Dry areas allow this option
- iii. Girdling or 'cincturing' to reduce flow of carbohydrate
 - Risky - girdle major limbs instead of the trunk
 - Wrap wounds with plastic to speed healing
 - Semi-circular wounding
 - Slash in spiral pattern

*Traditional method of encouraging a young tree to flower...slashed mango trees...

b. Banana

- i. Planting in Pits or Trenches: particularly useful in dry areas. Malawi example...
- ii. Mulching with cut banana stalks or other organic material

- iii. Irrigate with greywater in home gardens
- c. Papaya
 - i. Fertilization
 - ii. Irrigate during dry periods
 - iii. Mulch to preserve soil moisture

*Do not plant papaya in low/flood-prone areas due to susceptibility to root diseases

- d. Mango
 - i. Timing of pruning-tip pruning of small stems-5-6 months prior to optimal floral induction conditions (new flush should rest 4-5 months)
 - 1. young tree pruning
 - 2. multiplying terminals means you multiply fruiting potential
 - ii. Smudging/smoking-produces ethylene compounds...after flush is mature (Philippines)
 - iii. Potassium Nitrate application, Ethephon, Nitrate salt application to foliage (Rest breaking chemical application)
- e. Carambola
 - i. Bending upright stems-disrupt cambium...stress?
 - ii. Defoliation of stems...promotes flowering

Understanding the implications of seasons and environmental stimuli that your trees respond to in your location and understanding the implications of seasons classification (branched vs nonbranched, fruiting location) allows you to apply these management principles to any situation you encounter.

Resources and Works Cited:

Cull, B.W. Mango Crop Management. Acta Horticulturae 291, 1991.

Davenport, Thomas L. Processes Influencing Floral Initiation and Bloom: The Role of Phytohormones in a Conceptual Flowering Model. HorTechnology, October-December 2000.

Verheij, E.W.M. Towards a Classification of Tropical Fruit Trees. Acta Horticulturae 175, 1986.

Materials needed:

easel to set up charts

Phenology charts for Mango, Carambola, Papaya, Banana

small white board

potted example of each plant

- Feedback from Conference 2012:
- Need a handout
- multiple easels to keep phenology charts up
- Label months on charts as "1,2,3..." instead of Jan, Feb, etc.
- Less time at the beginning for discussion/other discussion
- Include agrodoc in handout
- State single stem/ branched as a fact from Verheij as a fact, not as a conclusion from discussion
- Address the problem of fruit tree management - how do you come up with a management plan for individual crops => need for Verheij's classification
- Understanding your trees
- Topic is really big
- Draw out temperature, rainfall first - transparencies?
- Stress Management
- How do you know when to fertilize, how do you know when to prune?

Original Document:

Verheij's classification of fruit trees:

Single-stemmed species

- a. Continuous growth, concurrent floral development
- b. Continuous growth culminating in flowering
 - i. largely supported by current photosynthesis
 - ii. largely supported by accumulated reserves

Branched Species

- a. Floral development concurs with extension growth
- b. Extension growth and floral development separated
 - i. separated by location
 1. cauliflory
 2. shoot dimorphism
 - ii. Separation in time
 1. growth rhythm synchronous
 2. growth rhythm asynchronous

Single stem Species

- a. Vegetative growth is higher priority for the plant than fruit production, but fruitfulness increases with an increase in growth
 - i. => they respond well to inputs
 1. ex: yields in banana

- b. Continuous growth
 - i. Virtually constant leaf area
 - ii. steady root growth
 - iii. => keeps the root:shoot ratio the same
- c. Concurrent floral development:
 - i. A period of stress means that fruiting will suffer more than growth
- d. Continuous growth culminating in flowering
 - i. A period of stress puts off the flowering
 - ii. Bananas and pineapples take longer to produce in the subtropics, high altitudes, but will still produce
 - iii. plants are more adaptable and flexible

Branched Stem

- a. Concurrent flowering and fruiting
 - i. usually on small trees
- b. Vegetative growth separated by location
 - i. Cauliflory
 - 1. occurs only in the tropics
 - 2. allows vegetative growth to still occur - can become year-round producers
 - ii. Shoot dimorphism
- c. Vegetative growth separated in time
- d. Synchronous vs. asynchronous
 - i. asynchronous
 - 1. originated in nonseasonal climates - they go by their own internal signals rather than environmental ones
 - ii. synchronous
 - 1. respond to stimuli in the environment
 - 2. in nonseasonal climates, these stimuli can be very weak

Phenology - "The study of natural phenomena that recur periodically, as migration of blossoming and their relation to climate and changes in season (over time)"

Why study phenology?

"To simplify a complex system - namely plant growth development and fruit production into a manageable system that can be dissected, investigated and manipulated to increase fruit production. To provide for an orderly research program and to provide a basis for management of the physiological factors contributing to productivity." "Crop Production, the Phenological Approach", J. H. Crane, pg 19.

To understand what the plant is doing when and what affects those processes and cycles.

Mapping out the different phases of a plant and the conditions that affect those phases

- a. Phases
 - i. flowering, fruit development
 - ii. root growth
 - iii. shoot growth

- iv. leaf drop, fruit drop
- b. environmental conditions:
 - i. precipitation (or soil moisture)
 - ii. temperature - air, soil

Final Overview

Single Stem species

- a. Top:root ratio - stable
- b. Yield -
 - i. high
 - ii. steady
 - iii. year-round
- c. Improving growth conditions increases fruit production more than growth
- d. Potential progress limited, priority
 - i. improve growing conditions
 - ii. plant breeding

Branched species

- a. top:root ratio - oscillating
- b. Yield -
 - i. low
 - ii. erratic
 - iii. mostly seasonal
- c. Improved growing conditions often stimulate growth at the expense of fruiting; fruiting has to be balanced with growth
- d. Potential progress spectacular
 - i. Manipulation of the tree

Taken from "Towards a Classification of Tropical Fruit Trees." Acta Horticulturae 175 1986, E. W. M. Verheij, pg 148.

AGRODOK 5: Fruit Growing in the Tropics. © Agromisa Foundation and CTA, Wageningen, 2006 http://journeytoforever.org/farm_library/AD5.pdf

To understand the tree's lifecycle and the processes, seen and unseen, that are occurring, over time, to better manage the tree and increase production.