Light interception into canopies

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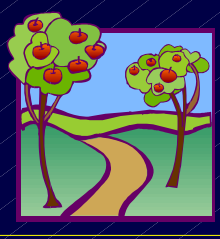
Light Interception

- Orchard production is directly related to the amount of light intercepted by the orchard



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Light Interception

- Economic fruit yields and fruit quality are a function of :
  - Light distribution within the canopy
  - Efficiency of light use

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Light Interception

- Orchard production is maximized at 70 % light interception

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Light Interception

- Light interception and distribution in an orchard is dependent on:
  - Orchard design
  - Tree training system
  - Pruning and training practices

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Orchard Design

- Spacing
  - Density
  - Tree height: tractor alley
- Row orientation
  - North- South
- Canopy characteristics

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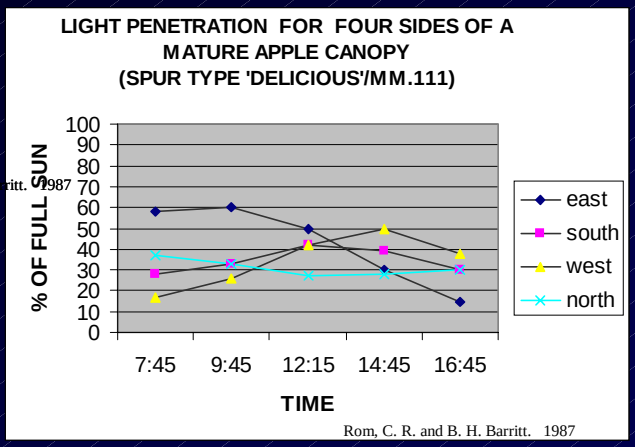
Light Penetration



Rom, C. R. and B. H. Barritt. 1987

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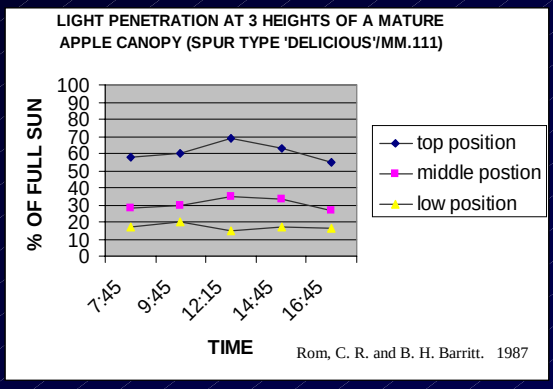
Light Penetration



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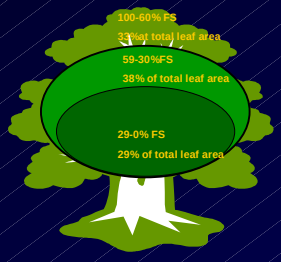
Rom, C. R. and B. H. Barritt. 1987

Light Penetration

Light penetration into the canopy of a large tree



Effective light penetration into an unrestricted canopy is ~ 1 m

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Light Penetration

Tree size

- As tree size decreases, the heavily shaded areas within the tree decreases

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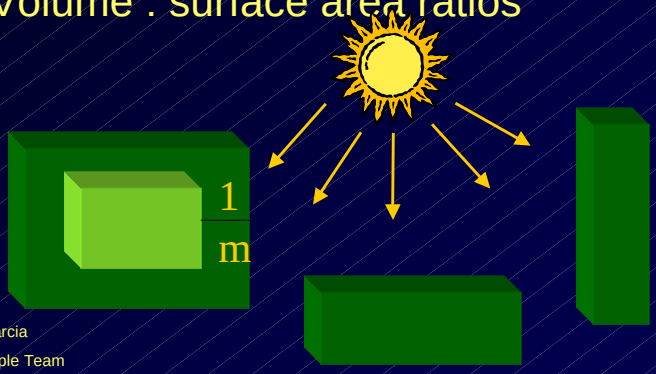
Light Penetration

Tree shape

- Volume : surface area ratios



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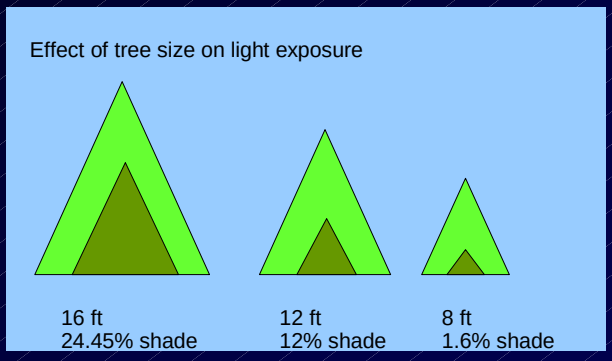
Light Penetration



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Light

- Large vs.. small trees
- Small McIntosh tree (10.5 ft branch spread) produced 80.6 % more fruit on a per unit area basis than a large tree (29.0 ft branch spread) (Forshey and McKee, 1970)

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Light Penetration

% of full radiation needed for various quality factors in apples

Character	Satisfactory development	Unsatisfactory development
Fruit size	>50%	<50%
Red color	>70%	<40%
Spur development	>30%	<25%

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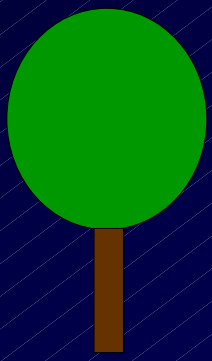
Apple Tree Canopy Forms

Globular

- Typical of large open center trees
- Very unproductive
  - Interior shading
- Productive area on top



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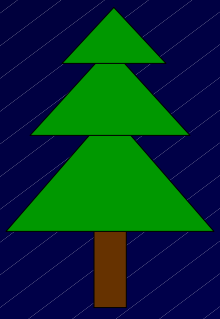
Apple Tree Canopy Forms

Conical

- Light efficient
- Open framework allows sunlight to penetrate the interior



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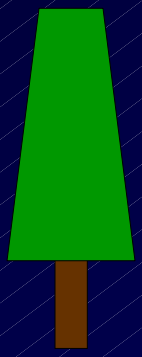
Apple Tree Canopy Forms

Vertical tree wall

- Branch spread is limited
- Adequate light penetration throughout the tree



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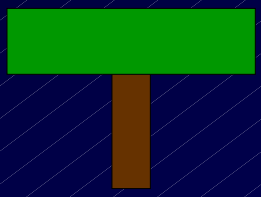
Apple Tree Canopy Forms

Horizontal

- Attempts to provide light exposure to the entire bearing surface



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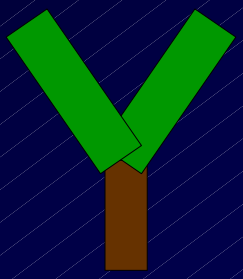
Apple Tree Canopy Forms

"Y" or "V"

- Maximizes light exposure of the bearing surface



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Training Systems

Objective:

- To maximize light penetration and distribution

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Common orchard Training Systems

Training system	General description	Advantages	Disadvantages	Density	Rootstock
Central leader	Free standing Most common Single, central trunk Pronounced conic shape Separate and distinct tiers of scaffold branches	High yields at full canopy High fruit quality	Slow to come into production High labor costs due to use of ladders and the pruning of large trees	Low to moderate 250-400 trees/Ac	MM.111 MM.106 M.7 Mark
Slender spindle	Needs support Very successful in Europe	Early cropping High tree density Minimal pruning Efficient use of labor	High initial cost Sunburn	High 800-1100	Dwarfing Rootstocks M.9 Mark
Vertical axis	Tall and narrow with a supported, dominant central leader	Early production Efficient use of labor	Tall trees require ladders Excessive growth of the central leader	500-700 trees/Ac	M. 9 EMLA 26 EMLA 7 EMLA 106

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Light penetration into different canopies

- Four sites were selected
- HRC and 3 orchards
- Light measurements into the canopy were taken with a Light Quantum Sensor instrument.

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Light penetration into different canopies

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Light penetration into different canopies

- In most instances, light readings were taken on one side of the canopy at
  - Outer (~ 2 ft)
  - Middle (~ 4 ft)
  - Interior (~ 6 ft)

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Central leader tree before summer pruning

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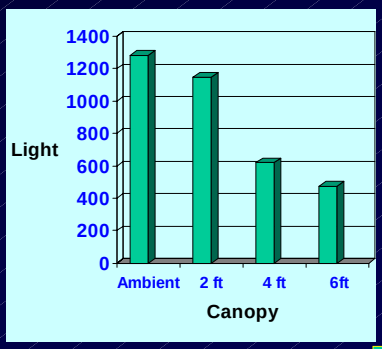
Light penetration

- Light Penetration into Central Leader (June 27, before summer pruning)
- HRC-McIntosh/M26
  - At 2 ft into canopy: 89%
  - At 4 ft into canopy: 48%
  - At 6 ft into canopy: 37%



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Pruned material

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Central leader trained tree after summer pruning

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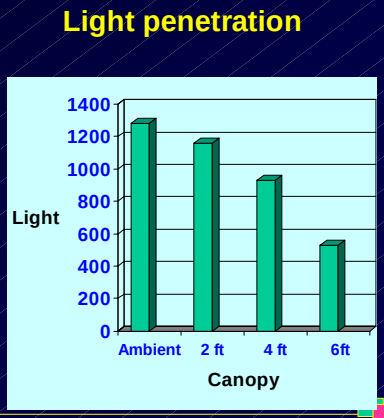
Light penetration into canopy

- Light penetration into Central Leader (June 27, after summer pruning)
- HRC-McIntosh/26
  - At 2 ft into canopy: 90%
  - At 4 ft into canopy: 72%
  - At 6 ft into canopy: 41%



Slender spindle/ Vertical axis trained tree before summer pruning

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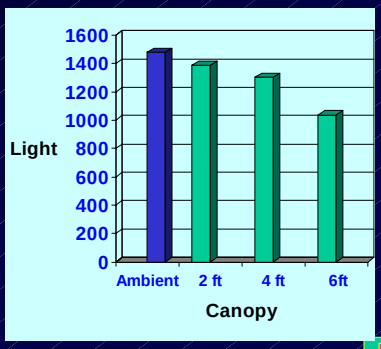
Light penetration into canopy

- Light penetration into Slender Spindle/Vertical Axis (June 27, before summer pruning)
- HRC-NE-183/M26
  - At 2 ft into canopy: 98%
  - At 4 ft into canopy: 92%
  - At 6 ft into canopy: 73%



Light penetration into canopy

Pruned material

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Light penetration into canopy

- Light penetration into Slender Spindle/Vertical Axis (June 27, before summer pruning)
- HRC-NE-183/M26
  - At 2 ft into canopy: 97%
  - At 4 ft into canopy: 98%
  - At 6 ft into canopy: 90%

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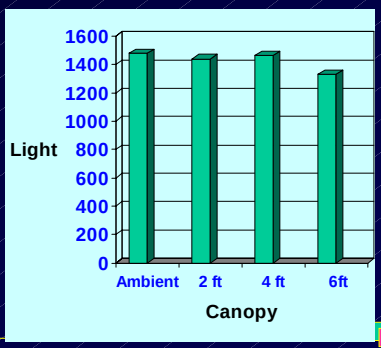

Light penetration into canopy

Slender spindle/ Vertical axis trained tree after summer pruning

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Light penetration into canopy

- Farm 1

Canopy	Lower tier (% light)
2 ft	99
4 ft	95
6 ft	60

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Light penetration into canopy

- Farm 1 (round canopy)

Canopy	Lower tier (% light)
2 ft	97
4 ft	45
6 ft	16

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Light penetration into canopy

- Farm 2 (standard size, pruned)

Canopy (apprx. depth)	Lower tier (% light)
2 ft	98
4 ft	85
6 ft	70
8 ft	38

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Light penetration into canopy

- Farm 2 (standard size, unpruned)

Canopy	Lower tier (% light)
2 ft	78
4 ft	20
6 ft	3
8 ft	5

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Light penetration into canopy

- It was dark inside!

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Light penetration into canopy

- Farm 3 (support with 4 wires)

Canopy (Avg 5 trees)	% light Avg (range)
2 ft	92 (100 –79)
4 ft	68 (100 – 42)
6 ft	56 (100 – 25)

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Light penetration into canopy

- Farm 3 'V' trellis

Canopy	% light (not pruned)	% light (pruned)
2 ft	80	89
4 ft	75	80
6 ft	50	69

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Summary

- Canopies can be modified
  - pruning and tree training
  - rootstock and scion
  - spacing

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- If what you want is this…..

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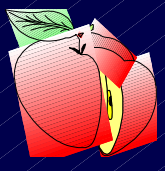
Summary

- Use techniques or practices that result in increase light distribution and interception
- This will result in improved fruit quality and yield



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Thank You