Orchard Density and Canopy Design

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Fundamentals of an apple canopy

- We need a rootstock and density that gives a low vigour, calm tree at maturity with good precocity and high yield efficiency
- The combination of rootstock, system and density must be able to fill the allotted space within 5 years
- A density and tree form that intercepts a minimum of 70% of total available light
- A canopy that has light distribution throughout the entire canopy capable of colouring fruit to market specification
- Tree density/canopy option must make good economic sense i.e. IRR > 15%
Rootstock Choice

Low vigour, precocious, efficient

- M9 and clones
- CG202
- M26

High vigour, less precocious, less efficient

- Seedling, Northern Spy
- M793, MM106, MM116
- MM111
# Current Industry Rootstock Use

## Australia
- Cripps Pink (8% M9, 20% M26, 40% MM106)
- Rosy Glow (15% M9, 50% M26, 25% MM106)
- 16% Red strains

## New Zealand
- Cripps Pink (35% M9, 15% M26, 30% MM106)
- Lady in Red (44% M9, 8% M26, 26% MM106)
- 40% Red strains
### Some Density/Canopy Options for 2015

<table>
<thead>
<tr>
<th>System</th>
<th>Rootstock</th>
<th>Density Range (m)</th>
<th>Typical Row Space (m)</th>
<th>Typical Tree Space (m)</th>
<th>Stems per ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright single leader spindle (now the NZ/Aust Std)</td>
<td>M9, CG202, M26</td>
<td>1500-3000</td>
<td>3.5-3.8</td>
<td>0.8-1.7</td>
<td>1500-3000</td>
</tr>
<tr>
<td>Upright twin stem spindle</td>
<td>M9, CG202, MM116</td>
<td>1250-2500</td>
<td>3.5-3.8</td>
<td>1.5-2.5</td>
<td>2500-5000</td>
</tr>
<tr>
<td>Dorigoni upright multi leader</td>
<td>M9</td>
<td>1850-2500</td>
<td>2.7</td>
<td>1.5-2.0 (2-4 stems/tree)</td>
<td>7400</td>
</tr>
<tr>
<td>2 Dimensional V with vertical branches</td>
<td>M9</td>
<td>3136</td>
<td>4.2</td>
<td>0.75</td>
<td>9408</td>
</tr>
<tr>
<td>2 Dimensional V with horizontal branches (Auvil)</td>
<td>Mark</td>
<td>3378</td>
<td>3.7</td>
<td>0.8</td>
<td>3378</td>
</tr>
<tr>
<td>Dorigoni pedestrian</td>
<td>M9</td>
<td>2666</td>
<td>2.25</td>
<td>1.5 (3 stems/tree)</td>
<td>8000</td>
</tr>
<tr>
<td>Plant and Food “Super Orchard” (Tustin et al)</td>
<td>M9</td>
<td>1667-2222</td>
<td>1.5-2.0</td>
<td>3.0 (10 stems/tree)</td>
<td>16670-22220</td>
</tr>
</tbody>
</table>

Assumes dwarf rootstocks

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**Experimental**

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**Some Density/Canopy Options for 2015**

- Assumes dwarf rootstocks
- 2Dimensional V with vertical branches
- 2Dimensional V with horizontal branches (Auvil)
- Dorigoni pedestrian
- Plant and Food “Super Orchard” (Tustin et al)
Upright Single Leader Spindle

- 1500-3000 trees per ha
- Good support (posts < 10m apart, wires every 50-60 cm)
- Tree height 1-1.2 times row width
- Branch bending if required
- Minimal to no branch shortening
- 7-9 branches per running m trunk
- Lots of “Calm” pendant fruit units
- Easy to maintain
Upright Twin Stem Spindle

- Calm fruit units
- Aiming to achieve a good number of stems per ha at 50% tree cost
- Less vigour than single leader, the more leaders the less vigour
- Requires very good tree support as no downward tree strength
- Ideal in a reworking scenario where tree space is too wide
Dorigoni upright multi leader fruit walls

• Calm fruit units
• Aiming to achieve a high number of stems per ha at reasonable tree cost
• Upright canopy allowing access to both sides
• Multi leaders gives vigour control over single leaders
• Row spacings down to 2.7 m
• Mechanical trimming used to manage canopy size
• Requires very good tree support as no downward tree strength
4 leader Pink Lady 5th leaf at 2.7 x 2.0m

Slide provided by Dr. Alberto Dorigoni (Italy)
4 leader Pink Lady 5th leaf at 2.7 x 2.0m spacing (70 tons/ha)

Slide provided by Dr. Alberto Dorigoni (Italy)
4 and 6 leader Golden Delicious 2.7 x 2.25 m

1650 trees/ha x 53kg/tree = 87 tons/ha

Slide provided by Dr. Alberto Dorigoni (Italy)
Multi-leader fruit wall

Slide provided by Dr. Alberto Dorigoni (Italy)
V Canopies

2D V with vertical branches

- Uses trees natural growth pattern
- Multiple leaders tends to lower vigour
- Very good light interception
- Calm fruit units
- Need to maintain light in lower canopy
2D V with horizontal branches

- Used very successfully by Auvil Fruit Co in the USA
- Precision horticulture
- Segmented system turns an orchard into a factory
- Maintenance of branch vigour requires expert horticultural knowledge and precise application
Photo supplied by Chris Peters,
Auvil Fruit Co USA
Upright 2D with horizontal branches

- Calm fruit units achieved by rootstock, crop load and growth regulators
- Significant set up costs
- Detailed management critical
- Very high fruit quality
Upright 2D with horizontal branches

Photo supplied by
Craig Hornblow AgFirst
NZ
Experimental canopies 2020 ??

Dr Dorigoni (Italy)
• Create a true pedestrian canopy that can match current yield potential.

Dr Tustin et al (Plant and Food NZ)
• Maximise light interception to lift Class 1 yield potential
Dorigoni Pedestrian

- 2.0 – 2.5 m row space
- 2.4 – 2.8 m tree space
- Multiple uprights 0.4-0.5 m apart
- Upright canopy allowing access to both sides
- Mechanical trimming
- Canopy no more than 2.5 m tall
- True pedestrian with yield potential of 100t/ha
Yield potential of different canopy structures

1:1

Slide provided by Dr. Alberto Dorigoni (Italy)
Double Guyot

Spacing: 2m (between rows) x 2.4 and 2m (between rows) x 2.8

Slide provided by Dr. Alberto Dorigoni (Italy)
Plant and Food “Super Orchard”

- 1.5-2.0 m row widths
- 3.0 m plant spacing
- 10 uprights per plant
- 1666 trees per ha or 16660 stems per ha
- 10.2 kg/stem or 50 apples per stem = 170 tonnes per ha
- Canopy height?? 1.5 x row width
Summary

- Dwarfing rootstocks
- Canopy full of calm low vigour fruiting units
- Canopies that are narrow not deep
- Canopies that minimise the need for structural wood
- Canopies that intercept a minimum of 70% of light preferably more
Summary continued

• Canopy options are multiple.
• Choose the one that you can make work
• The one that will give your business the best economic return
• The one that will get you out of bed everyday with a spring in your step.
• The one that produces a high yield of good quality fruit