**Summary of comments**

Good speakers/ relevant info, well run - Good networking
Well run/ excellent speakers (right on the money)
Very good and well organised - good to have speakers to time
Good value to address issues - good for young - not boring - keep working on same info
Variety informative - all new information
Very Good but need more interaction/ need stonefruit WIG

**Value good**
Value informative - excellent value - need larger format notes
Value good an v good networking - hold each year
Topics were important - more new info required
Well managed and excellent networking
Very good value

**Very informative lots to think about**
Good to see people
Varied interesting information
Very current and relevant - topics ".us do" worth the trip - suggest longer smokes
V Good info - most informative - more emphasis on consumer needs
Another great workshop - labour/ labour mg

Very good info offered. Keep to good orchards - avoid academists
Very good value
Very good Info - need to ensure issues for today

Worthwhile day - good range of topics - well organised = good networking - perhaps benchmark economics and more detail of orchard of future

Excellent - keep doing it
Excellent - keep doing it
Excellent value - hard to beat $ well spent
Informative - well worth the time and travel
Informative and excellent networking
Excellent - more on new tech/ equipment etc

Very good day - suggest visit to commercial orchards with speakers to talk on bus or in orchard
In any horticultural situation, an apple grower is concerned with controlling and even manipulating plant growth and development. The grower must provide for the plants the best conditions to produce the most efficient growth rate and the end product required. Therefore the processes which result in growth should be understood in order that the most economic growth results.

Importance of Water at Different Stages of Growth
Water stress at any stage of growth will affect the apple crop to some extent. However, there are certain stages of growth during which water stress will have a major effect.

- flower and fruit set;
- early fruit growth (4 weeks after fruit set) – fruit cell division takes place and this has an effect on final fruit size;
- early summer – this is the time when fruit bud formation for the following season’s crop begins;
- midsummer to early fruit maturity – adequate water is necessary for fruit cell enlargement and for continued development of the fruit buds;
- from harvest to early leaf senescence – good soil moisture will help to ensure a good build-up of reserves for the following season and will help to ensure strong fruit buds and therefore strong flowers for the following season.
**Fruit Tree Physiology**

- Photosynthesis is probably the single most important process which needs to be provided for when growing crops.
- Respiration is the process by which food matter produced by photosynthesis is converted into energy usable for growth of the plant.

**Photosynthesis**

- Photosynthesis is the process by which a green plant manufactures food in the form of carbohydrates such as sugars and starch, using light as energy.
- The rate of photosynthesis is influenced by the environment and as Orchardists we can regulate the rate of photosynthesis by altering the supply of these factors.

These include:
- Leaf area and age – managed by stimulating new growth
- Chlorophyll distribution – managed by stimulating new growth
- Light – managed by pruning/training/tree spacing
- Carbon dioxide levels – tree spacing effects
- Temperature – managed by tree spacing, irrigation, ground covers
- Water supply – managed by irrigation and drainage
- Nutrients – managed by fertilisers, foliar feeding

**Law of Limiting Factors**

- The Law of the Limiting Factors states:
  - That the factor in the least supply will limit the rate of photosynthesis
  - We cannot increase the rate of photosynthesis by increasing a factor already in adequate supply
  - We need to identify the lowest factor and increase it

**The Leaf**

- The leaf is the main site for photosynthesis
  - The larger the leaf surface area, the faster will be the rate of photosynthesis and the subsequent growth and development of the plant
- The leaf has four main functions
  - Manufacturing food by photosynthesis
  - Enabling the diffusion of gases from leaf to atmosphere
  - Transpiration and cooling
  - With modifications, as organs of food storage and vegetative propagation

**Respiration and Storage**

- Respiration is the use of sugars and starch, made during photosynthesis to release energy for the plant’s life sustaining processes
- All organisms need to respire
- Respiration is essential for plant growth and development
- The liberated energy is used for cell division and making useful plant substances, including cellulose in cell walls, proteins, enzymes and general growth and repair
- Respiration occurs most rapidly at the growing points of plants where cells are actively dividing eg roots and shoots
- As the energy is used for plant growth and development, respiration results in a decrease in plant sugars
- This is acceptable IF the sugars are being replaced through photosynthesis

**Fruit Tree Carbohydrate Storage**

- Storage carbohydrates produced by photosynthesis is stored in shoots, tree limbs and roots
- The flowering and fruit setting events in an apple tree’s life is the largest user of stored carbohydrates
- Current photosynthesis has not started producing carbohydrates for the tree to use until at least 3-4 weeks after flowering
- The period of time after harvest is critical to storing carbohydrate reserves for the coming season
- Any event that limits photosynthesis AFTER HARVEST will affect next years cropping through reduced carbohydrate storage eg drought/water stress, low nutrition, early leaf fall, leaf disease, etc
Fruit Tree Carbohydrate Storage cont.

- High Energy Use
  - Flowering
  - Fruit set
  - Fruit growth and development
  - Excess vegetative growth
  - Root growth
- NB. Keep these to a minimum!! Large limbs with high respiration and high carbohydrate storage that do not contribute to high fruit production.

How do we achieve a Fruit Tree Physiology Balance?

- Everything we do in an orchard must be targeted towards fruit production!
- We are growing fruit trees to produce fruit, NOT wood
- Only grow limbs large enough to sustain fruit production
- Produce enough leaves to support the fruit crop load
- Produce enough new shoots to support long term fruit production – renewal fruiting wood
- Maximise photosynthesis through good management of all cultural practices available to you; namely pruning and training, plant nutrition, irrigation and pest and disease control

Other Information

- Where does Australia stands in terms of World’s Best Practice?
  - Australia has access to some of the best technology in the world for apple production
  - As leaders in irrigation scheduling, plant nutrition and pruning and training techniques, Australian growers can and do produce some of the best fruit in the world
  - However, the challenge is to continue to produce top quality fruit every year with the lowest costs of production to maintain the profit margins

Management Program

Importance of Water at Different Stages of Growth

Water stress at any stage of growth will affect the apple crop to some extent. However, there are certain stages of growth during which water stress will have a major effect.

These are:
- Flower and fruit set;
- Early fruit growth (4 weeks after fruit set) – fruit set takes place and this has an effect on final fruit size;
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A New Approach to tree structure?
Craig hornblow

Objectives
What are we trying to achieve?

- High and early yields
- Cost efficiencies
- Consistency
- Quality fruit – What? (size, brix, colour, consistency)
**Visualise tree form**

**Which Tree Form?**

**Principals**  
*Understand the process.*

- Pruning influences vigour and crop load

**“Renewal pruning”**

- Severe renewal
- 3-year-old wood
- Moderate renewal
- 1 and 2-year-old wood
“Long pruning”

- Renewal of old fruiting branches
- Removal of old poorly located fruiting branches
- Removal of lateral branches

Understanding 35 year old technology
Fruiting branches

- Simple units
- The same from top to bottom
- Have simple math’s
- Ability for simple supervision
- Consistent light leads to consistent quality

These branches are created by training and pruning

Making it hard

Why is production dropping?
• Complexity fills the space with wood and leaves **not fruit buds**

*Creating a system*

*applying it consistently*

**“Long pruning”**

- Removal of old poorly located fruiting branches
- Removal of lateral branches
- Renewal of old fruiting branches
Performance is achieved through consistency

- High tree density
- Simples branches
- Simple management

Where to now??

- Is mastering this enough?
- What will your customers want from you?
- What will a great, Excellent industry look like in 5-10 years?
• Combining Regalis and pruning
Pruning and training.

- Why are we pruning?

1. Can be used to improve the tree shape.
2. To influence its growth, flowering and fruitfulness.
3. To repair injury.
4. To let more light in the tree.
5. Better spray penetrations.
6. Improve fruit quality.

- Pruning reduces root growth. Although not as obvious, pruning correspondingly reduces root growth, and new growth will be delayed until shoot growth in response to pruning occurs.
- Pruning will increase hormone levels and stimulate cell division. After that shoot growth will occur.

- Generally, many small cuts stimulate more shoot growth, reduce fruiting to a greater degree and alter the tree balance more than from a few large cuts.
- Larger cuts result in fewer, more vigorous and more localized re-growth.
- Effect on fruit: one of the primary reasons for annual pruning is to increase fruit size. Fruit set is higher on pruned trees because the supply of reserves available to remaining blossom is increased.
- More light, higher spur quality.
- Try to grow a well balanced tree.
- The greatest vigour is always in the top of the tree. The more the branches are upright the more the new shoots will grow.
- Get rid of bad upright limbs in the top of the tree. Keep as many 2 year old fruiting wood as possible in the bottom of the tree.

**Training**

Training, in contrast to pruning, refers to the directions of tree growth or form and the development of the structural frame work of the tree.
- Training is mostly confined to the period when the tree is becoming established.
- The ultimate goal of both pruning and training is to improve light distribution so that as much of the tree canopy as possible maintains production of high quality fruit.
Effects from pruning on growth.

- Removal of the branch not only removes stored carbohydrate and nitrogen reserves but also reduces potential leaf surface and growing points as well.
- Although not as obvious pruning reduce root growth and new root growth will be delayed until shoot growth in response to pruning occurs.
- There is a fundamental balance between the above - and below – ground components of an apple tree.
- Removal of a portion of either the top or the root system slows growth until the balance is re-established. (Taylor and Ferree, 1981)

Pruning the top during the dormant season increase hormone levels and are probably responsible for stimulating cell division and ultimately shoot growth, which in turn, promotes auxin production in shoot tips and gibberellin production in new unfolding leaves.

- This is why pruning has an effect on flowering and fruit bearing. Generally fruit set is higher on pruned trees because the supply of reserves available to the remaining blossom is increased. Cell division early in the season is greater in the areas of the canopy that have high light and large spur leaves areas. Later in the season during cell expansion shoot leaves supply the fruit. Fruit size is closely related to spur leaf area.

Root pruning

- Root pruning was widely practised in European gardens to reduce tree size and promote flowering in the 1800s.
- Root pruning reduces net photosynthesis, transpiration and leaf water potential.
- In the field root pruning reduced trunk cross section, shoot length, shoot number to spur ratio, shoot leaf size and shoot leaf area in cropping apples trees.
- The overall growth effects resulting from root pruning are sufficient to reduce pruning time and increase within - canopy light levels. Canopy light penetration and spur quality are increased. The more severe ( the closer to the trunk) the root pruning the greater are the effects on growth.
Improving Nutrient Uptake
Understanding tree physiology and seasonal variability to maximise nutrient uptake and profit

Doris Blaesing, Serve-Ag Pty Ltd

MAXIMISING PROFIT
Profit Driver: yield and pack-out of first grade fruit
Required: excellent storage potential
Desired: predictable performance
Needed: good risk management

WHAT DOES ORCHARD NUTRITION HAVE TO DO WITH PROFIT?
Most post harvest disorders are related to nutrient imbalances in the fruit, often produced during very early fruit development

One-fits all fertiliser recipes and the use of the same complete fertilisers over several years may have to be reviewed

Why recipes cannot give reliable results

Yield levels: Variety / rootstock / density / training
Soil conditions: Physical, chemical, biological
Climate: Temperatures (day / night), humidity

All impact on:
Root distribution, growth, function & nutrient uptake

TREE SPACING and ROOT GROWTH
Distance
Shoot weight
Root weight
Exploitable soil volume

Replace recipes with nutrient budgeting
Supply what is needed, when is it needed (will vary with season)
Correct soil deficiencies and imbalances first
Use uptake & removal figures and physiology principles to develop the fertiliser program
Consider soil, water and climatic conditions
Identify and correct insufficient nutrient uptake and imbalances during the season
Correct soil deficiencies and imbalances

A SOIL test shows potential nutrient availability

Rootzone to about 40cm

WATER AND NUTRIENT EXTRACTION HAPPENS IN THE ENTIRE ROOTZONE

Use uptake & removal figures and physiology principles to develop the fertiliser program

EXAMPLE OF ANNUAL NUTRIENT UPTAKE PER 10 TONNE APPLES

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Uptake (kg/ha)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>33</td>
<td>25%</td>
</tr>
<tr>
<td>P</td>
<td>4.8</td>
<td>4%</td>
</tr>
<tr>
<td>K</td>
<td>40.5</td>
<td>31%</td>
</tr>
<tr>
<td>Mg</td>
<td>7.6</td>
<td>6%</td>
</tr>
</tbody>
</table>

Averages from several sources

Correct soil deficiencies and imbalances

Apples, averages from several sources

Comparison between ‘nutrient replacement’ and fertiliser ‘recipes’

Nutrient removal through prunings and fruit - apples

Assumptions for apples: 50kg fruit/tree, 1000 trees/ha
Supply Calcium (Ca) to fruit at the right time

Ca uptake important 10 to 45 days after petal fall, later in the season, shoots become major sinks.

Supply Ca to fruit at the right time

"Simultaneous high supply of calcium and nitrate increased calcium and boron transport into young fruit."

"Transport of calcium (and boron) to the fruit decreased during fruit development" while fruit potassium and magnesium levels keep increasing more or less in proportion to fruit expansion.

Supply Ca to fruit EARLY!

Ca uptake into young fruit occurs via the Xylem (water and dissolved mineral transport system), due to the pressure gradient caused by transpiration.

As fruit matures (cell expansion) an increasing amount of assimilates are transported into fruit via the Phloem (system for transporting synthesized materials).

NUTRIENT FUNCTIONS

Growth – N (tree & fruit), P (roots & fruit set), Mg (photosynthesis)

Fruit size & quality – K (water relations), Ca (cell strength)

Storage quality – N/Ca, K/Ca (K+Mg/Ca meq – bitter pit risk)

B, Zn, Mn – trace elements to watch

Ratios & balances most important!!

DESIRED NUTRIENT BALANCES – N/Ca

Ca uptake into shoots increases during the season relative to N

Ca uptake into fruit remains constant relative to N (Ca = 3x N)

DESIRED NUTRIENT BALANCES – K/Ca

Ca uptake into shoots increases during the season relative to K

Ca uptake into fruit remains constant relative to K (Ca = K/10)
Consider soil, water and climatic conditions

Soil management (mulching, green manures etc) may have a greater impact on nutrient availability than fertiliser applications.

- e.g. 20 – 300 kg nitrogen per hectare may become available depending on the soil management system.
- Monitor soil nitrogen levels if you use organic materials, soil conditioners etc.
- Soil moisture monitoring is a prerequisite for managing nutrient uptake.

SEASONAL VARIABILITY:
Adjust the nutrient budget

1. ‘Best bet’ for crop load, weather etc.

2. Monitor to correct insufficient nutrient uptake and imbalances during the season.

Nutrient uptake testing using sap analysis:

- Early season testing, fast turnaround
- Detect problems before symptoms appear
- Confirm fertiliser efficacy (root function)
- Test ‘sinks’ (shoot tips, young fruit).

Consider soil, water and climatic conditions

Soil moisture monitoring is a prerequisite for managing nutrient uptake.

Nutrient uptake testing using sap analysis:

- Early season testing, fast turnaround
- Detect problems before symptoms appear
- Confirm fertiliser efficacy (root function)
- Test ‘sinks’ (shoot tips, young fruit).

Tissue Analysis

- Bank balance

Sap Analysis

- Account movements

BANK BALANCE - ACCOUNT MOVEMENTS

Nutrition summary: nutrient accumulation in the sampled plant part up to the time of sampling.

Nutrient uptake (and mobilisation) around the time of sampling = current nutrient availability.

Tissue analysis tells how much the plant has extracted from the soil up to the time of sampling. Temporary deficiencies may only be detected if they persisted for long enough.

Sap analysis, especially early in the season assists in fine tuning the current season’s nutrient plan and detects changes in nutrient supply or uptake conditions as they occur.

Foliar Feeding

- Enhances growth and development when normal uptake via the root system is temporarily poor.
- It is a supplement, not a substitute for soil application, but may improve uptake via roots.
- Leaves become more waxy during the season, which decreases foliar uptake.

Foliar nutrients can be used effectively to maintain a nutrient balance, when testing has shown a deficiency.
In Summary

Replace recipes with a nutrient budgeting approach under consideration of:

- General and orchard specific tree & fruit growth processes
- Soil and root status
- Seasonal conditions
Using Plant Growth Regulators to Add Value to Apple Production

Schalk Reynolds
Marketing Manager
Plant Growth Regulators

Valent BioSciences Corporation

- At the present time, VBC is the company with the most extensive and diverse portfolio of PGR’s that:
  - Add value to the production process through increases in productivity and quality
  - Valent’s PGR uses result in a consistent and measurable Return on Investment to the End User

Plant Growth Regulator Use

- Objectives / Benefits:
  - Improve quality
  - Increase yield
  - Overcome genetic limitations
  - Overcome adverse climatic conditions
  - Reduce labor costs
  - Improve/extend post harvest life
  - Technological tools to optimize crop management

You need experience to optimize the use of Plant Growth Regulators ……!
**Uses of PGR'S on apples**

- **OBJECTIVE**
  - Delay Flowering
  - Advance flowering and uniform budbreak
  - Thinning
  - Promote flowering
  - Improve fruit shape
  - Improve fruit size

- **PRODUCTS**
  - Ethephon (post harvest, fall)
  - Hydrogen Cyanimide, (Dormex), Winter oil
  - NAA, NAD, Carbaryl, Ethephon, ATS, Cylex
  - Ethephon
  - GA4+7/6BA (Cytolin)
  - GA4+7/6BA (Cytolin), 6BA (Cylex)

**Uses of PGR’S on apples**

- **OBJECTIVE**
  - Russet Control
  - Reduce vegetative growth
  - Lateral branching
  - Reduce suckers
  - Advance maturation
  - Delay ripening
  - Fruit drop Control

- **PRODUCTS**
  - GA4+7 (Regulex, Cytolin)
  - Prohexadione calcium (Apogee), Paclobutrazol (Cultar)
  - GA4+7/6BA (Cytolin)
  - Auxins & NAA
  - Ethephon
  - AVG (ReTain), 1-MCP (Smartfresh)
  - NAA, Dichlorprop, AVG (ReTain)

**VBC - PGR Product Line**

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>VBC Brand Names</th>
<th>Product Features and Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA3 (Gibberellic Acid)</td>
<td>ProGibb</td>
<td>Increases yields, improves quality on table grapes, citrus, cherries and many other fruits &amp; vegetables and agronomic crops.</td>
</tr>
<tr>
<td>GA4+7</td>
<td>ProVide</td>
<td>Improves germination &amp; stimulates early growth on rice.</td>
</tr>
<tr>
<td>GA4+7/6BA</td>
<td>Promalin</td>
<td>Reduces russet &amp; improves fruit finish &amp; quality on apples.</td>
</tr>
<tr>
<td>6-BA</td>
<td>Berelex</td>
<td>Improves fruit quality and reduces russet on apples.</td>
</tr>
<tr>
<td>Aminoethoxyvinylglycine (AVG)</td>
<td>ReTain</td>
<td>Manages fruit maturation and ripening for optimum harvest, quality &amp; storage on apples. Fruit set on Walnuts etc.</td>
</tr>
</tbody>
</table>

**Cytolin/Promalin on Royal Gala**

Morza - Curico, Chile

**Cytolin/Promalin on Royal Gala**

Morza - Curico, Chile

**Cytolin/Promalin on Royal Gala**

Morza - Curico, Chile

**Effect of Cytolin/Promalin on Fuji-Pack out Washington 1994**

<table>
<thead>
<tr>
<th>% of boxes per group</th>
<th>136-125</th>
<th>113-100</th>
<th>88-80</th>
<th>59-52.5</th>
<th>14-4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promalin x 2 L/Ha</td>
<td>4</td>
<td>4.5</td>
<td>23</td>
<td>36.5</td>
<td>60</td>
</tr>
<tr>
<td>Control</td>
<td>4</td>
<td>6.5</td>
<td>23</td>
<td>36.5</td>
<td>60</td>
</tr>
</tbody>
</table>
“Retiform” Russet on Golden Delicious
Cytalin/Promalin vs. Untreated Control

Cytalin/Promalin on Golden Delicious
Ceres, South Africa
Russet Control

Latest trends with Cytalin/Promalin

- Reduction of Red Delicious globally, but the use of Cytalin became a standard practice on Gala. Focus on increasing fruit size on Gala.
- Global focus on fruit quality - Cytalin part of program
- Increased use on other “newer” varieties:
  - Several Gala selections, Fuji, Braeburn, Pink Lady, Sundowner: Size and Quality.
- Used in combination with Cylex / MaxCel
  - Standard program in the US and will be in other markets
  - Increased use for fruit set on pears:
    - Conference, Comice, Abate Fetel, Williams etc.

The impact of the shift in count size (Fig. 6) of Cytolin/Promalin, Cylex and Cytalin/Promalin+Cylex treatments on the economics of ‘Brookfield Gala’ apples in Hawkes Bay, New Zealand [data supplied by John Wilton and incorporated into Wilton (2004a); ‘dollars’ are NZ$].

<table>
<thead>
<tr>
<th></th>
<th>Untreated</th>
<th>Promalin</th>
<th>Cylex</th>
<th>Promalin + Cylex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit/tree</td>
<td>296</td>
<td>259</td>
<td>228</td>
<td>224</td>
</tr>
<tr>
<td>On tree value/ha</td>
<td>$10,850</td>
<td>$11,207</td>
<td>$12,314</td>
<td>$21,379</td>
</tr>
<tr>
<td>Increased Value</td>
<td>$357</td>
<td>$1,464</td>
<td>$10,529</td>
<td></td>
</tr>
<tr>
<td>Ave Count Size</td>
<td>141.4</td>
<td>132</td>
<td>134.1</td>
<td>121.3</td>
</tr>
</tbody>
</table>

Cylex / MaxCel (6BA)

- Apples:
  - A key component of a thinning and sizing program for most apple cultivars.
  - It increases fruit size beyond the direct thinning effect.
  - Strong return bloom agent (reduces alternate bearing)
### Cylex / MaxCel - Return On Investment

**US**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Yield (cartons / Acre)</th>
<th>% Fruit in &gt;3 inch diameter</th>
<th>Gross Income $ / Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaxCel + Sevin (1 Pt / Acre)</td>
<td>1,183</td>
<td>46.1</td>
<td>$10,315</td>
</tr>
<tr>
<td>NAA (10 PPM) + Sevin (1 Pt / Acre)</td>
<td>1,025</td>
<td>20.9</td>
<td>$15,359</td>
</tr>
<tr>
<td>Difference</td>
<td></td>
<td></td>
<td>-$5,956 (+$9,494 / Ha)</td>
</tr>
</tbody>
</table>

Golden Delicious, NY, 2003. MaxCel applied @ 8 - 10 mm Spray volume (1,000 L / Ha)

**France**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fruit / 100 clusters</th>
<th>% Fruit &gt; 70 mm</th>
<th>Gross Income Euro / Hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>120.4a</td>
<td>13.0</td>
<td>13,982</td>
</tr>
<tr>
<td>NAA (15 PPM)</td>
<td>56.6b</td>
<td>36.4c</td>
<td>19,307</td>
</tr>
<tr>
<td>MaxCel (100 PPM)</td>
<td>47.2bc</td>
<td>60.9b</td>
<td>22,969</td>
</tr>
<tr>
<td>MaxCel (200 PPM)</td>
<td>70.7c</td>
<td>69.6ab</td>
<td>24,366</td>
</tr>
<tr>
<td>MaxCel + NAA (80 + 10 PPM)</td>
<td>32.2c</td>
<td>89.7ab</td>
<td>27,261</td>
</tr>
</tbody>
</table>

Pink Lady, Marsillargues, France (Gerard Ferre), 2003 MaxCel applied @12 mm Spray volume (1,250 L / Ha)

### Cylex / MaxCel - Return On Investment

**Italy**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fruit / Trunk Section</th>
<th>% Fruit &gt; 30 mm</th>
<th>Gross Income Euro / Hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>10.8a</td>
<td>2.7c</td>
<td>3,350</td>
</tr>
<tr>
<td>NAA (10 PPM)</td>
<td>7.9bc</td>
<td>26.4b</td>
<td>8,758 bc</td>
</tr>
<tr>
<td>MaxCel 75 PPM</td>
<td>7.6bc</td>
<td>26.3a</td>
<td>10,132</td>
</tr>
<tr>
<td>MaxCel 100 PPM</td>
<td>7.3bc</td>
<td>30.0a</td>
<td>9,177 bc</td>
</tr>
<tr>
<td>MaxCel 150 PPM</td>
<td>5.7cd</td>
<td>42.4ab</td>
<td>9,365 ab</td>
</tr>
<tr>
<td>MaxCel + NAA (100 + 15 PPM)</td>
<td>3.3c</td>
<td>55.2ab</td>
<td>7,401</td>
</tr>
</tbody>
</table>

Golden Delicious, Alto Adige, Italy (Dr Dorigoni) 2003 MaxCel applied @ 10 - 12 mm Spray volume (1,400 L / Ha)

### Retain (AVG)

- **Mode of Action**
  - Retain is a plant growth regulator that blocks ethylene production in plants. By reducing ethylene production in fruit trees, Retain slows the processes that cause fruit to ripen.

- **Product Benefits for apples**
  - Reduces pre-harvest fruit drop
  - Harvest management tool - Extends harvest period without loss of fruit firmness or quality
  - Maintains fruit firmness
  - Improves storage potential
  - Improved fruit color and size (indirect)

### Retain Golden Delicious - South Africa

![Untreated Retain](image)

### Retain McIntosh - USA

![Untreated Retain](image)
ReTain Pink Lady – South Africa

Harvest Management

Harvest % at each pick

Red Color at Harvest

ReTain Pink Lady - South Africa

Watercore

ReTain on Fuji in New Zealand.

Watercore

ReTain Pink Lady - South Africa

Greasiness (Y/N)

After CA storage (6 months)

ReTain Gala – New Zealand

The effect of ReTain 7 DBH on starch conversion of Brookfield Gala (Nelson, NZ) – Hormblow & Smith 2002

Watercore

ReTain on Fuji in New Zealand.

Watercore

ReTain Pink Lady - South Africa

Greasiness (Y/N)

After CA storage (6 months)

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Watercore

ReTain on Fuji in New Zealand.
ReTain Pink Lady – Australia

Rate of ethylene production of Pink Lady apples from Batlow 2004

ReTain: Return on Investment

• How to calculate the return on investment
  – Price differential vs. fruit quality
  – The savings in the harvesting process
  • Reduced drop: less culls.
  • Less pickings
  • More uniform maturity
  – Increased fruit size – (increased yield)
  – Long term storage opportunity
  – Other quality benefits (colour)

ReTain Economics

% Packout – Size Increase

<table>
<thead>
<tr>
<th>Box Size</th>
<th>Price/Box</th>
<th>ReTain</th>
<th>Untreated</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Boxes</td>
<td>Number</td>
<td>Number</td>
<td></td>
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<tr>
<td>56</td>
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<td>Total</td>
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Benefits

$1,318/Acre ($3,163/Ha)

Data: Glenwood Orchards, Gala, Lower Yakima Valley, WA

ReTain Economics

McIntosh Apples, New York

Drop Control Benefit

<table>
<thead>
<tr>
<th>Yield</th>
<th>% Drop</th>
<th>Fresh Min.</th>
<th>Fresh Max.</th>
<th>Acre</th>
<th>Number/Boxes</th>
<th>Sales</th>
<th>Total ($)</th>
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<tbody>
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<tr>
<td>ReTain</td>
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<td>13.5</td>
<td>904</td>
<td>142</td>
<td>710</td>
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<tr>
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<td>502</td>
<td>562</td>
<td>525</td>
<td>2,625</td>
<td>11,787</td>
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</tbody>
</table>

ReTain benefit is $5,421 / Acre

$ 13,010/ Ha

Thank you