Thirsty vines can give tasty fruit, but at a cost...

Summer girdling - current options and new ideas

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2007 weather roundup - Bob McDavitt

Barriers to adoption of tools to lift kiwifruit dry matter
Bill Snelgar has worked as a plant physiologist for DSIR/HortResearch for 21 years. He is based in Te Puke and his work has focused on the flowering ability and cropping behaviour of kiwifruit vines. He has published a number of articles on shading, shelterbelts, vine trellis systems, stubbing, late tipping and winter chilling. Recently his work has focused on predicting fruit growth and dry matter in relation to climate. This work led to the creation of a web-based system (KSRL) for predicting budbreak and fruit size. This system is supported by a network of 19 meteorological stations. He is currently working with COKA to find a budbreak enhancer for organic growers.

Ross Atkinson is Science Leader for the Flavour Biotechnologies team at HortResearch, Mt Albert. He uses molecular biology to investigate the regulation of kiwifruit flavour/aroma production and changes that occur in the cell wall during fruit ripening.

Mike Currie is based in Auckland and works exclusively with kiwifruit for orchard systems research and development of new cultivars. Before joining HortResearch in 1998, Mike completed a horticulture degree and PhD at Massey University.

Shane holds the position of ZESPRI Innovation Leader- Tech Transfer. He has a passion for the effective transfer of industry ideas into research programmes and for research findings to be delivered in ways that maximise uptake both for the New Zealand kiwifruit industry and ZESPRI contracted parties offshore. His background is in commercial horticulture and research orchard management. He works closely with HortResearch and other research providers to ensure successful technology transfer within the kiwifruit sector.

Peter joined the plant physiology team at the Te Puke HortResearch Centre in 2002, bringing with him 20 years’ experience in the local kiwifruit industry. Most of his recent work has involved commercial trials looking at improving fruit quality in Hort16A and Hayward Kiwifruit.

Helen works with the Flavour Biotechnology team at HortResearch. Interests include the effect of plant metabolism on fruit sweetness and acidity and its relationship to flavour. Specialising in carbohydrate and acid determination using GC, HPLC(IC) and sugar metabolism using radiometric techniques for a wide range of plant species.
BOB MCDAVITT
Bob graduated with a degree in Maths and Computer Science from Victoria University in Wellington in 1974. He has been a meteorologist since 1975, forecasting for marine, aviation and the general media around New Zealand and in Fiji. He is a veteran from two campaigns for the America’s Cup (in Perth and San Diego). As Weather Ambassador, Bob McDavitt has been in Auckland since 1992, communicating awareness about incoming weather events, keeping an eye on the impact of weather on special events and arranging MetService promotions, displays, and exhibitions. He writes voyage forecasts for sailors cruising around the South Pacific and has compiled a book called the “Mariners Met Pack”. He took over the writing of MetService seasonal outlooks from Augie Auer in 1998 and continues to keep a keen eye on the weather patterns for the coming season.

KEN MARSH
Ken Marsh is a scientist at HortResearch, who has worked in the areas of plant nutrition and carbohydrate metabolism. He now specialises in fruit acidity and is part of a small group studying kiwifruit genes which affect metabolite production and kiwifruit flavour. He has previously worked on metabolism changes which bring about low acidity in citrus, and currently works on the enzymes controlling quinic acid metabolism in kiwifruit.

MIKE SPIERS
Mike Spiers is based at HortResearch, Ruakura and works on a range of projects involving soil quality, plant nutrition and biological disease control in kiwifruit, grapes, summerfruit, vegetables and forestry. A further area of interest is compost and potting mixes, especially performance assessment.

SOPHIA MAX
Sophia Max recently gained a 1st Honours Degree in Human Resource Management at Victoria University of Wellington. She has worked as a seasonal worker in the kiwifruit industry. She has now headed off to the United Kingdom on her OE.

TESSA MILLS
Tessa Mills has worked for HortResearch for 17 years and is currently working in the sustainable land use team based in Palmerston North. Currently, her primary focus of research is irrigation strategy and nutrition of kiwifruit.

GRAHAM WIGGINS
Graham Wiggins has been involved in the kiwifruit industry for over 10 years and is a past President of the Tauranga Fruitgrowers’ Association. He is a kiwifruit grower and has run a postharvest facility. He is the current President of NZKGI.
PETER MINCHIN

Dr Peter Minchin has recently returned to HortResearch after three years working in Germany. He was the joint winner (with Dr Michael Thorpe) of the inaugural Outstanding Physiologist award in 2001, given by the New Zealand Society of Plant Physiologists. Prior to this, Peter was a joint recipient of the Award for Excellence in Scientific Research for work on the understanding of phloem transport in plants. Peter has studied phloem transport for 30 years and is now recognised as a world expert in this field. His work now includes modelling fruit growth of Hort16A, colour development of Hort16A and understanding the control of carbohydrate allocation between fruit and vegetative growth in both kiwifruit and avocado.

GRANT THORP

Dr Grant Thorp is a HortResearch scientist based at the Mt Albert Research Centre in Auckland. Grant is well known in the kiwifruit and avocado sectors for his work on pruning and vine management systems and how these affect fruit yield and quality. Current projects include research on leader pruning systems for Hayward vines and development of management systems using Alternate Year Cropping, reflective ground covers and the new kiwifruit rootstocks being developed by HortResearch to increase yields of high dry matter fruit.

TIM WOODWARD

Tim Woodward has been based at the Te Puke Research Centre where he has been completing his PhD on variability in kiwifruit quality characteristics. He is now Extension Coordinator with ZESPRI Innovation.

SANDY SCARROW

Sandy Scarrow is a horticultural consultant with 18 years experience working in the Bay of Plenty. She began work as a Horticultural Advisory Officer in Whakatane after graduating from Massey with a Bachelor of Horticultural Science. Sandy continued with Agriculture New Zealand when it was sold by MAF until she and her colleagues undertook a management buy out to form Fruition Horticulture in November 2003. Typically her work is focused on consultancy, policy analysis and training in the kiwifruit industry but also involves environmental projects such as one looking at the sustainable management of on-farm plastics and unwanted agrichemicals.

ANNETTE RICHARDSON

Annette Richardson is a plant physiologist based at HortResearch Kerikeri. Annette has worked for HortResearch for in excess of 20 years and her specialities are budbreak flowering and fruit development.

ANDREW BARNETT

Andrew has been with HortResearch for over 20 years. A research physiologist, Andrew has been involved in organising numerous research trials, many on local grower properties and some overseas. His practical knowledge and experience enables him to readily translate science ideas into practical reality.
Thirsty vines can give tasty fruit, but at a cost…

Mike Currie, HortResearch - Mt Albert, Steve Green, HortResearch - Palmerston North
Philip Martin and Nicola Currie, HortResearch - Te Puke

Allowing Hayward vines in Gisborne to develop severe water stress in 2007 gave a massive improvement in dry matter, but with a corresponding loss of fruit size and yield, which would have reduced financial returns. However, over-watering vines should also be avoided because this can result in root health issues as well as costs to the environment.

WATER STRESS AND TASTE

A wide body of published information on other fruit crops (e.g. grape, peach, apple) suggests that regulated deficit irrigation can elevate dry matter (DM) levels in fruit, without necessarily affecting yields (FAO 2002). Historic research conducted on potted Hayward kiwifruit vines suggested that mild water stress during summer can increase dry matter of the fruit (Miller et al. 1998). While there are also many anecdotal reports suggesting that fruit from water-stressed field grown vines have better flavour, the feasibility of this response had not been confirmed with field trials.

Some growers also believe that late-season rainfall reduces fruit DM, by diluting fruit constituents. Recent studies at Te Puke suggested these effects may be small (Currie & Nicholls 2006), although impacts in very dry conditions were not tested at that time.

WATER STRESS AND FRUIT GROWTH

The sensitivity of fruit growth to soil water availability has been well documented for kiwifruit (Judd et al. 1989; Smith & Buwalda 1994). Inadequate soil moisture can result in significantly smaller fruit, particularly early in the growing season when the fruit are in their most rapid phase of growth (Figure 1).

Irrigation is not generally considered a key input on many Bay of Plenty orchards, because the soils are deep and they have sufficient water-holding capacity to limit the effects of summer drought. However, on the lighter pumice soils in eastern Bay of Plenty, very low available moisture reserves are held in the soil and in most seasons there are periods when vines are likely to experience moisture stress. In other parts of the country such as Kerikeri, Gisborne and Nelson, rainfall can be lower and the soils are shallower so there is a greater likelihood of water stress developing during summer.

2007 - A VERY DRY SUMMER

This past growing season was one of the driest on record. In Gisborne, the period between January and April 2007 was the third driest it has been in the last 36 years and there was insufficient rainfall to meet vine needs (Table 1). This made 2007 an excellent year to investigate how water deficits could affect fruit dry matter and yields in field conditions. It would be fair to say that the research team were very pleased with their good fortune - normally conducting any water stress research in New Zealand will guarantee persistently heavy rainfall for the entire season!

2007 TRIALS IN GISBORNE

At a commercial Hayward orchard in Gisborne (Figure 2), a trial was initiated where vines received one of three treatments:
1. Full-irrigation: All vines were irrigated according to the orchard manager’s irrigation schedule. Irrigation was delivered via a single micro jet (24 L hour⁻¹) on each vine. The vines were typically irrigated for an eight-hour period, once or twice per week, from mid season through until harvest. This treatment served as the control.

2. Half-irrigation: All vines were irrigated according to the same schedule as full-irrigation vines, but using only half the amount of water. It was not possible to source micro-jets with a flow rate < 25 L hour⁻¹. So, for this treatment, three pressure-compensated drippers (4 L hour⁻¹) were installed on each vine, to deliver water at a rate of 12 L hour⁻¹ vine⁻¹. Although, these emitters would have provided a different water distribution (narrower root zone being wetted), we do not believe that this would have had a major impact on the results.

3. Quarter-irrigation: All vines were irrigated according to the same schedule as full-irrigation vines, but using only one quarter the amount of water. This was achieved by replacing each microjet with three pressure-compensated drippers (2 L hour⁻¹) on each vine, to deliver water at a rate of 6 L hour⁻¹ vine⁻¹.

The soils at the orchard were a Matawhereo heavy silt loam. Irrigation scheduling was carried out by the orchard manager on the basis of guidance provided by a consultant. Deficit irrigation treatments were imposed on 4 January 2007 and continued until 2 April 2007, at which time the drippers were replaced by the original micro-jets and all vines were then fully irrigated to simulate late-season rainfall. A total of 350 mm of irrigation was applied between November and mid April to all the full-irrigation vines as well as the remainder of the orchard. The deficit irrigation treatments applied between 100 and 150 mm less water to the vines (Figure 3).

**Irrigation was needed to avoid soil water deficits**

Time domain reflectometry (TDR) probes were installed in the root-zone soil to a depth of 1.4 m to monitor soil water at different depths (Figure 4). These probes provide a highly accurate measurement of soil moisture providing they are correctly installed. It was clear that without full irrigation, significant soil moisture deficits developed over the growing season (Figure 5):
• For full-irrigation vines, there was very little change in the soil moisture below 80 cm, and soil water contents at depths of 40 - 60 cm began to rewet from mid January, indicating that excess water was simply draining through the root-zone and leading to very wet subsoil.

• For reduced irrigation vines, soil moisture levels began to decline very soon after the irrigation treatments were imposed, even at depths below 80 cm. There was a progressive decline in soil moisture in the top 1.4 m of soil (Figure 5). However, the full re-irrigation in early April, combined with a large rainfall event a few days earlier, resulted in rewetting and some drainage beyond 60 cm.

The volume of water applied to full-irrigation vines in this trial was actually well in excess of plant requirements from mid January onwards. This over-watering resulted in increasing soil moisture levels at lower depths and the soil remained close to saturated there for virtually the entire summer period. Plant roots must acquire oxygen from soil pores for normal function and roots will become stressed if there is insufficient available oxygen (hypoxia), or die if soil pores are completely saturated with water, so that there is no oxygen available (anoxia). Overwatering combined with poor drainage is likely to result in root anoxia (Patterson 2004) and increases the risk that diseases such as Phytophthora root rots could occur (Max et al. 2007). These can result in loss of root function or root death and also plant death. For example, there were significant deaths of Hayward vines in 1989 in Kerikeri after very heavy rainfall, possibly as a result of anoxia (McAneney et al. 1989). The absence of vine roots in deeper soil layers during soil sampling in Gisborne this year was consistent with anoxia: even if plant deaths did not occur, it is likely that plants will be less resilient to other stresses in the long term.

**DRY MATTER WAS INCREASED, BUT FRUIT SIZE WAS DECREASED**...

Applying less than full-irrigation increased fruit DM levels, but also caused a significant reduction in fruit size (Table 2). For example, applying quarter-irrigation increased DM by 1.6 per cent-units, but reduced fruit weight (FW) by 8.9 g. We calculated that this would have reduced yield by c. 1,200 tray equivalents (TE) per ha. Despite the gain in T2G with this reduced irrigation, the loss of yield would have resulted in orchard gate returns (OGR) being reduced by c. $6,900/ha. Similar impacts on DM, FW and yield were observed in the half-irrigation treatments, although impacts were smaller. When we tested the impacts of different pricing mechanisms, a maximum taste payment equivalent to 120 per cent of fruit payment would have been required before the deficit irrigation treatments would have produced a similar OGR to the full-irrigation treatment. Note that we have not included an estimate of what the reduced costs to run the irrigation would have been. Reducing the frequency of irrigation should reduce power and maintenance costs as well as reducing the environmental costs in terms of nutrient leaching.

A clearance sample could have cleared fruit from the quarter-irrigation treatment to be harvested about one week earlier in Week 13 (26 March - 1 April) (Figure 6). In this case, the DM of fruit from the quarter-irrigation treatment would have been about 0.3 per cent-units lower but Kiwistart incentives would have been higher. Even in this scenario, there would still have been a reduced OGR compared with fully irrigated vines, but this would only have been c. $4,800/ha.

The increase in DM under deficit irrigation probably occurred via reduced dilution of carbohydrates during the starch accumulation phase of fruit growth (Richardson & Currie 2007). Although water deficits markedly reduced fruit expansion over the summer period (22 per cent), there was a disproportionate decrease in fruit dry...
weight (seven per cent). It is likely that although leaf function (photosynthesis) would have been reduced under the water deficits, root demand for carbohydrates may also have been reduced, resulting in a higher proportion of photosynthates going to the fruit.

**RE-IRRIGATING DRY VINES HAD MINIMAL IMPACT CLOSE TO HARVEST**

There was some evidence that re-irrigating the vines in April had only a small impact on dry matter of fruit from deficit-irrigated vines (Figure 6). The impact of this late irrigation was to reduce dry matter accumulation of fruit from quarter-irrigation vines by 0.2 per cent-units, relative to full-irrigation, although this effect could not be determined with any statistical confidence within our experimental design. Even if this were the case, the shift was very small and would have had little effect on orchard returns. These results are consistent with a study conducted in 2005, where the impacts of heavy rainfall close to harvest were found to be quite small (Currie & Nicholls 2006). Both results strongly suggest that kiwifruit growers need not be concerned that sampling or harvesting soon after rainfall or irrigation will result in reduced fruit dry matter.

**FRUIT FROM WATER DEFICIT TREATMENTS STORED WELL**

Although fruit at this orchard were suitable for early supply, when we stored fruit harvested in early April, the rate of fruit softening in cold storage or after shelf storage at 20°C was not accelerated by deficit irrigation. In fact there was some evidence that fruit from deficit-irrigated plots maintained a higher firmness for much longer. Alternatively, it is possible that fruit from fully irrigated vines actually softened faster than ideal. Although this study does not replicate fully the impacts of handling and storage that would otherwise occur in commercial postharvest systems, the results do not identify any risk that deficit irrigation would lead to poor storage of early harvested fruit. However, impacts that deficit irrigation might have on advancing fruit maturation would need to be considered when scheduling harvests. Clearance to pick could be obtained at an earlier date for early harvest windows. However, if fruit were harvested late in the season, it is possible that they could become over-ripe and thus less suitable for long-term storage.

### Table 2. Effects of irrigation treatments at a Gisborne Hayward orchard on fruit attributes in March/April 2007 (n=3 plots).

<table>
<thead>
<tr>
<th>Irrigation treatment</th>
<th>Fruit weight (g)</th>
<th>Dry matter (%)</th>
<th>Soluble solid content (%)</th>
<th>TZG</th>
<th>Yield (TE/ha)</th>
<th>OGR ($/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-irrigation</td>
<td>101.2 a</td>
<td>17.36 a</td>
<td>5.77 a</td>
<td>0.552</td>
<td>8,400</td>
<td>$38,200</td>
</tr>
<tr>
<td>Half-irrigation</td>
<td>97.8 b</td>
<td>17.77 a</td>
<td>6.05 a</td>
<td>0.613</td>
<td>8,000</td>
<td>$35,300</td>
</tr>
<tr>
<td>Quarter-irrigation</td>
<td>92.3 c</td>
<td>18.95 b</td>
<td>6.63 b</td>
<td>0.764</td>
<td>7,200</td>
<td>$31,300</td>
</tr>
</tbody>
</table>

Means in a column with the same letter are not significantly different at P=0.05 (LSD).

TE = tray equivalents, TZG = Taste ZESPRI™ grade, OGR = estimated orchard gate return (gross return less postharvest costs, based on $3.72/TE fruit payment, TZG payments based on maximum $1.88/TE, KiwiStart incentive payments for week 14 based on $1.45/TE and postharvest costs of $2.95/TE).

![Figure 6. Changes in Gisborne Hayward fruit weight, dry matter and soluble solids of fruit from full-irrigation and deficit irrigation treatments in 2007.](image-url)
Fruit from this experiment had not fully ripened by the time of reporting. Even after 24 weeks of cold-storage at 0°C followed by 1 week at 20°C, fruit from almost all the treatments were not at eating firmness and none had reached their full soluble solids content (SSC) potential. The difference between harvest DM and SSC for fully ripe Hayward kiwifruit should be between 2.7 and 3.0 units (Burdon et al. 2004). In our trials, the differences were between 3.4 units (full-irrigation) and 4.0 units (quarter-irrigation). We could assume that fruit would have ripened normally, if they had been treated with ethylene gas. However, it would be useful to confirm that this would occur and that fruit from deficit-irrigated vines do achieve improved eating qualities in any future research.

ARE WATER DEFICITS FEASIBLE AS A TOOL FOR KIWIFRUIT GROWERS?

Using severe water deficits to increase kiwifruit dry matter would not be feasible for kiwifruit growers, at least with the current payment incentives for dry matter and size. The fruit payment benefits that would have been received this season for the increased DM would have more than been offset because:

1. Yield of Class 1 trays would have been reduced, as more of the (smaller) fruit would have been required to fill each tray
2. The fruit size payment profile would have become less favourable, because of the smaller fruit size
3. The KiwiStart payment would have been reduced because of smaller fruit.

The management of soil water deficit was relatively crude in this study. We simply reduced the irrigation volumes mid season and waited for an outcome, relying on orchard management to schedule irrigation across the entire orchard. However, it is still possible that the controlled use of mild water deficits, as part of a regulated water deficit (RDI) strategy, could be feasible in some situations. On other crops such as apple (Ebel et al. 1995) and peach (Chalmers et al. 1981; Goldhammer et al. 2002), RDI strategies can successfully target water stress to periods when fruit are growing slowly and/or when active shoot growth is occurring. For example, water deficits are often used in wine grapes to reduce unnecessary vegetative growth (Dry et al. 2001), which can increase fruit DM and reduce pruning costs. The potential for RDI strategies to benefit Hayward vines may be small with the current low-vigour management systems. However, there may be a greater ability for such strategies to benefit Hort16A, which usually displays a vigorous growth flush over the summer period between January and March. Hort16A trials are currently underway in Te Puke as part of a MAF Sustainable Farming Fund (SFF) co-funded project (Project TZ0736).

Table 3. Effects of irrigation treatments at a Gisborne Hayward orchard on fruit firmness after 24 weeks of cold storage at 0°C and fruit attributes after one week of shelf storage at 20°C (n=3 plots). Fruit were harvested on 4 April.

For a harvest date, means in a column with the same letter are not significantly different at P=0.05 (LSD).

<table>
<thead>
<tr>
<th>Irrigation treatment</th>
<th>Fruit firmness from cold store,19 Sep.(kgf)</th>
<th>Fruit firmness after 1 week at 20°C, 26 Sep.(kgf)</th>
<th>Fruit soluble solids content after 1 week at20°C, 26 Sep.(%)</th>
<th>Incidence of ‘over soft’ fruit(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-irrigation</td>
<td>1.4 a</td>
<td>0.7 a</td>
<td>13.7 a</td>
<td>15 a</td>
</tr>
<tr>
<td>Half-irrigation</td>
<td>1.9 b</td>
<td>1.0 b</td>
<td>14.3 a</td>
<td>7 b</td>
</tr>
<tr>
<td>Quarter-irrigation</td>
<td>2.4 c</td>
<td>1.4 c</td>
<td>14.7 a</td>
<td>4 b</td>
</tr>
</tbody>
</table>
SUMMARY

We now have an indication of the likely responses of Hayward kiwifruit to water deficits in the field. The key findings were that:

1. The deficit irrigation treatment can increase fruit dry matter, in this case by up to 1.6 per cent-units. However, there is likely to be a corresponding decrease in fruit size, yield and orchard gate returns under current pricing mechanisms. Therefore, the deliberate use of deficit irrigation to raise fruit dry matter would not be economically feasible for most Hayward kiwifruit orchards.

2. Re-irrigating deficit irrigation treatments in April did not significantly alter fruit dry matter or weight. This result suggests that kiwifruit growers need not be concerned that sampling or harvesting soon after rainfall or irrigation will result in substantially reduced fruit dry matter.

3. There was no evidence that postharvest storage performance of fruit from deficit-irrigated vines was negatively affected; fruit remained firmer than those from full-irrigation treatments throughout storage. However, ripening of fruit from deficit-irrigated treatments appeared to be significantly delayed.

4. Excessive irrigation should be discouraged, as it is likely to have long-term impacts on productivity if root health is compromised and could result in unnecessary environmental costs (leaching of soluble nutrients, carbon emissions via power usage). Significant root health issues have been observed in the Gisborne area that could be exacerbated with over-irrigation, particularly where there is poor drainage.

ACKNOWLEDGEMENTS

We would like to acknowledge and thank Cedric Whitters and Brian Alley from Kaiapori farms for their assistance in conducting this research.

REFERENCES


Although summer (February) trunk girdling is an easy and effective way to increase dry matter, it may not suit all orchards. February cane girdling can also be effective and different timings of girdling may suit some orchards. Here we review results from a range of trials and describe how growers can run their own trials.

2007 TRIALS IN WHANGAREI AND NELSON

In 2006, ZESPRI were fielding reports that trunk girdling was not effective in some regions such as Whangarei and Nelson. To determine if there was any evidence to support this, trials were set up with two Hayward orchards in each of these regions (Figure 1). In Nelson, the practice of summer cane girdling was also included, as some orchardists in the region had reported that this was as effective on their vines (Figure 2).

It was clear that in most of the sites, there was an acceptable response to trunk girdling. For example, at Whangarei orchard 1, dry matter was increased by over one percent - unit. This would translate to a lift in Taste ZESPRI™ Grade (TZG) of c. 0.15 units. Alongside this was an impressive gain of c. 8 g of fruit weight. We estimated that this sort of response would have lifted production at this orchard by c. 800 trays/ha and orchard returns by c. $8,000/ha (ZESPRI Canopy website OGR calculator). Fruit at both Nelson orchards also responded fairly well to trunk girdling plus showed some response to cane girdling. This suggests that Nelson growers are correct that summer cane girdling is effective, although our results suggest that trunk girdling would be more effective for them, as long as vines were healthy.

At one of the Whangarei sites, there was no response to trunk girdling at all, for either dry matter or fruit weight. This is the first time that we have recorded a nil response to trunk girdling in a replicated trial ever and demonstrates that the technique cannot be guaranteed to work every single time! In some ways, we are not altogether surprised. Responses to girdles applied to Katikati orchards have often been better than in Te Puke orchards in our trials. Although we cannot fully explain these differences, there is a range of possibilities that could explain why trunk girdling can appear to have been less effective in some situations, such as:

- Vines were different to start with. This can often be the case when individual blocks or maturity areas are compared with one another. However, with randomisation and replication procedures used in research trials this is less likely. In our case, we had actually collected a sample of fruit at the start of the experiment in February that confirmed that the two sets of vines had been initially very similar.
• Girdles incorrectly applied. If girdles were not applied to the correct depth so that all phloem is removed, then the vine responses could be lower. However, in this case, the research team did double check and are confident that girdles were applied correctly at the Whangarei sites.

• Root system already under stress. If roots on vines were importing less carbohydrate than normal, then the presence of a girdle could have had little effect. Although dry conditions could have resulted in limited root growth (and therefore less demand for carbohydrates) in the summer period, there dry matter levels on all the vines were relatively low, which would not suggest that they had been water stressed (see Currie et al. 2007a, this issue).

• Vines ‘Source limited’. If canopy photosynthesis (carbohydrate source) was already very low, then girdling may not have altered carbohydrate allocation significantly.

• Girdles heal too fast. It is possible that if girdles have healed very quickly, there may have been insufficient time for fruit to accumulate extra carbohydrates.

• Low Potential. Low flower quality meant the fruit had a low potential for size and/or dry matter and this was reached even without trunk girdling.

With the orchardists’ support we hope to look at these vines again in 2008 and see if these responses are consistent. This will be reported on later in the year.

<table>
<thead>
<tr>
<th>Orchard</th>
<th>Control</th>
<th>Dry matter (%)</th>
<th>Cane girdled</th>
<th>Control</th>
<th>Fruit weight (g)</th>
<th>Cane girdled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Trunkgirdled</td>
<td></td>
<td></td>
<td>Trunkgirdled</td>
<td></td>
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<tr>
<td>Whangarei 1</td>
<td>16.9</td>
<td>18.0</td>
<td>-</td>
<td>111</td>
<td>119</td>
<td>-</td>
</tr>
<tr>
<td>Whangarei 2</td>
<td>15.9</td>
<td>15.9</td>
<td>-</td>
<td>108</td>
<td>107</td>
<td>-</td>
</tr>
<tr>
<td>Nelson 1</td>
<td>16.2</td>
<td>17.0</td>
<td>16.3</td>
<td>94</td>
<td>97</td>
<td>93</td>
</tr>
<tr>
<td>Nelson 2</td>
<td>16.3</td>
<td>16.9</td>
<td>16.7</td>
<td>99</td>
<td>106</td>
<td>103</td>
</tr>
</tbody>
</table>

Table 1. Dry matter and fruit fresh weight from Hayward vines that were summer trunk or cane girdled in Whangarei or Nelson in February 2007. Treatments were replicated on 10 vines at each site. * Mean was significantly different from control at P=0.05 (LSD).
Summer trunk girdling has proven to be a fairly robust and successful strategy for kiwifruit growers to increase dry matter. Although results from 2006 above show that there are orchards in which girdling may not work every season, the costs of applying girdles are very low, so even if they are not effective, there is only minimal financial outlay for orchardists.

However, for a range of reasons, some may choose not to trunk girdle their vines. These reasons could include:

- Concern whether trunk girdling is sustainable in the long term
- Believing that trunk girdling will not work on their orchard
- Already achieving high dry matter and yield via expert canopy management and therefore no requirement for a further boost to productivity
- No need for increases in flowering, which could result in increased thinning costs
- The increased risk of harvest/postharvest issues with advancing fruit maturity
- Vine health issues such as widespread trunk diseases and poor root health, preclude use of girdling.

For some of these orchardists, summer cane girdling could be a useful alternative (Currie et al. 2007e). But just how effective is summer cane girdling really? To find out, we reviewed available datasets from a range of summer trunk and cane girdling studies conducted in New Zealand orchards over the past nine years.

Although summer cane girdling appeared to be somewhat effective, summer trunk girdling consistently outperformed summer cane girdling. For both Hayward and Hort16A kiwifruit, the responses of fruit weight and dry matter for trunk girdling were almost twice as high overall (Table 2, Figure 3). The exception was for Hort16A fruit weight, where there appeared to be only a small response of c. 2 g for both types of summer girdling. This is not surprising, as by the time summer girdles are applied in mid February, Hort16A fruit have typically already accumulated 80 per cent of their final weight (Minchin et al. 2003).

It was also clear from these datasets that summer cane girdling had the disadvantage of increasing variability (variance) of dry matter (Table 2) as described in Currie (2007d). This is likely to result in less uniform fruit quality, which would not be desirable in markets. In contrast, there was some evidence that trunk girdling does actually reduce variability, particularly for Hort16A. This may be because trunk girdling allows a "free" flow of carbohydrate around the fruiting canopy, allowing fruiting canes with excess to export to canes with less, but without the influence of root competition which could affect some fruit more than others. In contrast, cane girdling locks carbohydrate available within each cane, preventing flow between canes.

TRUNK GIRDLING V. CANE GIRDLING

Summer trunk girdling has proven to be a fairly robust and successful strategy for kiwifruit growers to increase dry matter. Although results from 2006 above show that there are orchards in which girdling may not work every season, the costs of applying girdles are very low, so even if they are not effective, there is only minimal financial outlay for orchardists.

However, for a range of reasons, some may choose not to trunk girdle their vines. These reasons could include:

- Concern whether trunk girdling is sustainable in the long term
- Believing that trunk girdling will not work on their orchard

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REMINDER – VINE HEALTH PRECAUTIONS AND GIRDLING TECHNIQUE

We remind orchardists who are planning to trunk girdle that precautions should be taken to minimise any risk of introducing vine diseases into open girdling wounds. Any diseased vines should be marked and avoided, and girdling tools should be sterilised by dipping them into methylated spirits as often as possible.
Operators should also avoid cutting deeply into the wood with very sharp girdling chains. Blunting any new chains with a file or grinder is recommended.

For more information, growers can refer to articles in the May 2007 Kiwifruit Journals (Currie et al. 2007b; Manning et al. 2007; Max et al. 2007).

OTHER GIRDLING OPPORTUNITIES

Some other opportunities for using trunk girdling are being evaluated in long-term research trials that are starting this year. These include the use of multiple trunk girdles at different times of the year such as spring and autumn. We’ll be reporting on the performance and sustainability of these over the next few years. However, we cannot cover all options with dedicated research trials, so there are still opportunities for orchardists to fine-tune girdling on their properties. Some topics that could be investigated by innovative orchardists or technical staff include:

- **Timing of spring trunk girdles.** Currently we are suggesting spring trunk girdles be applied at a similar time to cane girdles, about four weeks after mid bloom (Refer KiwiTech Bulletin #3). However, timing trials have not been conducted and earlier timing may be appropriate if it does not reduce dry matter, particularly for Hayward vines that are also being summer girdled, where the interval between girdles could otherwise be relatively short.

- **Summer girdling in January.** January girdling could be worth testing if orchardists were concerned about healing before winter and/or if very early harvests were anticipated, so that fruit have more time to gain the maximum response. Alternatively, if orchardists wanted to girdle vines just once in the season, there is some evidence that a girdle applied eight to ten weeks after flowering (mid January for Hayward) could allow a proportion of both the spring fruit size and summer dry matter responses to be obtained.

- **Repeat summer girdling.** Girdling in both February and March has the potential to maximise the dry matter response and to improve flowering markedly. While this may not always be desirable, orchardists in warm areas may benefit from additional flower numbers and could consider testing this.

- **Healing of girdles under black tape or fungicidal paints.** There is some evidence that girdles heal more quickly under black insulation tape. The protection of wounds with pruning paints could help to reduce the chances of any vine diseases infecting wounds. However, this has not been established with any certainty.

- **Different girdling methods.** Some orchardists have come up with alternative ways to girdle plants such as using knife girdlers (figure 4), which could heal more quickly and appear to be almost as effective as full girdles (Currie et al. 2006). Applications on Hort16A scions v. rootstocks or girdling over old wounds are also often queried. Orchardists could consider confirming if such options made any difference to healing rates or fruit responses.

RUNNING YOUR OWN TRIALS

In the November 2007 issue of the Kiwifruit Journal, we discussed how orchardists could run their own trials incorporating concepts of replication, randomisation and controls (Currie et al. 2007c). Trials with summer or autumn trunk girdling options such as those suggested in the previous section are ideal ones to try, with only a few vines. To assist those wanting to do this, HortResearch and ZESPRI are developing an easy-to-use template in Microsoft® Excel that can be used to design such a trial (Kiwifruit Trial Designer).
The Kiwifruit Trial Designer will allow a grower to select up to ten different treatments and creates a unique design based on the block layout and number of replicates required, where treatments are randomly assigned to individual vines (Figure 5), and vines colour coded corresponding to different flagging colours that can be attached to the vines in the field (Figure 6). A list is also generated showing row and plant numbers of every vine being used in the trial, where measurements can be entered.

The next phase of design will be to develop tools that enable basic analysis of the data entered and generate reports that describe the impacts of the treatments. Watch this space! In the meantime, innovative orchardists can obtain a copy of the trial designer from the research team, or by contacting ZESPRI Innovation.

SUMMARY

Although girdling is a relatively simple and straightforward technology to use, clearly responses will vary depending on seasonal and orchard factors. Key things to note from this article include:

1. Trunk girdling can definitely be effective at raising dry matter in regions such as Whangarei and Nelson, but responses can vary and there are orchards where trunk girdling could actually be ineffective in some years.

2. Summer cane girdling is also effective at raising dry matter, but will result in a smaller response and less consistent fruit quality.

3. Orchardists can test how effective different trunk girdling options are on their own orchards by running simple trials. Contact the research team for assistance.

4. A Microsoft® Excel spreadsheet Kiwifruit Trial Designer suitable for designing simple field trials is available for testing this season. Interested kiwifruit growers and technical reps can contact ZESPRI Innovation, or a member of the research team for a copy.

ACKNOWLEDGEMENTS

We would like to acknowledge and thank Mike Crum, Dennis Enright, Terry Fry and Phil Jones for their assistance and participation in research trials.

REFERENCES

Kiwitech Bulletin #3: Cane Girdling. Available from ZESPRI


“Some consider the application of HC to be the management practice that currently has the greatest single effect on the profitability of kiwifruit production in New Zealand”, and...

“The high variability from year to year is a result of winter chilling which accounted for 84% of the variation in the amount of natural bud break and 78% of the amount of flowering.”

Source: McPherson, Richardson, Snelgar and Currie; New Zealand Journal of Crop & Horticultural Science, 2001

Erger-G has been used successfully in New Zealand on apple, cherry, blackcurrant and brambles and since 2000 some observations with Erger-K have been made on kiwifruit in the Bay of Plenty. Our experience and that of others would suggest kiwifruit to be a complex crop and therefore in the last three seasons we have made 14 trials or comparisons on Gold and 29 on Hayward.

Erger-K is composed of 8% nitrogen, 2.3% oligopeptides, 0.8% citric acid and 50% organic matter. Calcium nitrate, CAN or Active Erger is added to the Erger-K to form the sprayed solution. This added fertiliser gives the plant food to stimulate the normal winter processes, so that when the spring conditions of temperature and day length return the vine is able to respond. This helps explain some of the results as outlined below.

In all situations were Erger-K has been compared to untreated there has been beneficial effects on % bud break, flower numbers per shoot, fruit size and flowering compaction. The following example is from a high altitude Hayward orchard in Tauranga. Part of this increase has arisen from fruit numbers and part form an increase in fruit size.

<table>
<thead>
<tr>
<th>fruit/cane</th>
<th>canes/bay</th>
<th>$/100 fruit</th>
<th>$/bay</th>
<th>$/ha</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erger</td>
<td>27.41</td>
<td>16</td>
<td>16.35</td>
<td>72</td>
<td>35845</td>
</tr>
<tr>
<td>Untreated</td>
<td>23.73</td>
<td>16</td>
<td>15.48</td>
<td>59</td>
<td>29386</td>
</tr>
<tr>
<td>difference</td>
<td></td>
<td></td>
<td></td>
<td>6459</td>
<td></td>
</tr>
</tbody>
</table>

When comparing Erger-K to HC the normal pattern has been for and increase in flowers per bud and a decrease in % bud break with an overall result of more flowers per square meter of canopy. Bud break will occur later when treated with Erger-K and we have seen earlier harvests in Gold. In the 2006 harvest differences of between 2-14 days were noted from packhouse records, with up to 19 days in the 2007 harvest. An untreated comparison last year showed a 21 day difference in maturity clearance. Generally the clearance protocols were the same.

The following is an example from a Gold block in Opotiki

<table>
<thead>
<tr>
<th>% bud break</th>
<th>flowers/ shoot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erger</td>
<td>hydrogen cyanamide</td>
</tr>
<tr>
<td>81</td>
<td>88</td>
</tr>
<tr>
<td>2.88</td>
<td>2.21</td>
</tr>
</tbody>
</table>
What about fruit size?

With correct application timing we have been able to measure an increase in fruit size in comparison to untreated and hydrogen cyanamide treated orchards.

```
mid Feb to mid May
1 2 3 4
cubic mm/100

Erger-K  Untreated
```

Rediscovering Natural Bud Break

The main factors of interest in contributing to poor results are late applications as Erger-K needs to be sprayed earlier than normal HC timing, and two, not knowing when natural bud break is likely to occur. Label recommendations are for 40-45 days before natural bud break and many of us have lost the knowledge of when that time is. Some recognition also needs to be made of the seasonal winter chilling differences particularly in the May-June-July period.

Erger-K has performed well and consistently in Gold kiwifruit and we are finding that the reliability of performance in Hayward is increasing as our knowledge base expands. It is now time for many more growers to start gaining experience with this product so that when hydrogen cyanamide is no longer available there is a replacement ready to go!

In Summary

- Erger-K is different to hydrogen cyanamide, with a different mode of action
- The end result is a similar number of fruit per square meter
- Erger-K needs to be thought of as a fertiliser
- Application is earlier than HC, and bud break is delayed to better weather
- Application is independent of weather conditions
- Earlier harvest on Gold
- An increase in fruit size is possible

On Erger trial site Emanuele Aquafredda Valagro Sales manager Richard Mills Valagro Pacific, and Simon Budd Horticentre who has made some major contributions to the research programme.

Information on ERGER K Available from

Pacific Growers Distributors for Valagro SPA

Tony Andrews
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Simon Budd
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Gearing up ‘Hort16A’ Returns


HortResearch’s High Production treatment increased Orchard Gate Return by $17,000/ha in a trial in a high performing Alternate Row Cropping orchard. In the Innovative Growing Systems project, use was made of Extenday® reflective ground covers and artificial pollination to achieve this. Seventy percent of the increase can be attributed to an increase in TZG payments.

In the April 2007 edition of the Kiwifruit Journal we introduced readers to the Innovative Growing Systems project, funded by ZESPRI Innovation. In this project, HortResearch scientists are working alongside three high performing, innovative orchardists and their management teams. We plan to investigate the opportunities to increase fruit yields and to monitor the consequences of these on fruit quality and grower returns over a three-year period. Here we report on the outcome after the first year of the trial at one of the sites, Don and Judy Hyland’s Hort16A orchard near Te Puke. The vines at this orchard are being managed on an Alternate Row Cropping (ARC) or sometimes called Alternative Year Cropping system.

Details of the ARC system have previously been reported in “Pushing the boundaries” (April 2007 Kiwifruit Journal) and “Is there one right way to grow Hort16A?” (November 2006). In summary, it is a string-assisted system that allows vines in every second row to crop over the combined area of two rows (in this case 8.6 m wide canopy), every second year. Vines in cropping rows are alternated...
every second year with non-cropping vines trained only to grow replacement canes. Small strip males grafted into female leaders run across the block in every bay. Historical yields on the orchard were in the 14 to 18,000 te/ha range.

HortResearch set up some ‘High Production’ (HP) plots in Block F of this orchard to assess whether the standard orchard management could be further improved. The HP treatment consisted of:

1. Supplemental artificial pollination
2. Extenday® reflective ground covers erected both vertically (in this case, every third row) and horizontally on the ground.
3. In addition less NAA-gel pruning was applied, and instead large fruiting shoots were either zero-leaf pruned or left intact.

**ORCHARD MANAGEMENT**

All vines in Control and HP plots in the trial block were treated the same for fertilizer inputs, Benefit GOLD applications (three applied) and trunk girdling (one girdle in February). Bird damage in spring meant there was no need to thin to adjust crop load. A small number of fruitlets were removed from the ends of very thin canes where fruit would not have made export grade for blemish or size reasons. Differences in vine management between the HP and Control vines were:

1. Reflective Ground Covers: HP vines had Extenday® reflective fabric installed on 11 October 2006 as a complete ground cover (88 per cent of the surface) beneath the 20 vines (Figure 3). Extenday® was also installed as an 1.25 m vertical fence beneath the leader of every vine in the first and last rows of each block on 12 December 2006. Extenday® New Zealand Ltd provided the reflective fabric and attachment cords and hooks at no cost to the project. Reflective materials were left in place until harvest.

2. Supplemental Pollination. The HP vines were artificially pollinated with three wet pollen applications during flowering (courtesy of PollenPlus®).

3. Canopy Management. Very little NAA-gel was applied to the HP vines while a relatively low level of gel use was used in the Control vines. In the HP vines greater use was made of shoot removal or zero-leaf pruning. All vines generally had relatively low vigour compared with industry norms due to the high crop load and extended leaders and canopy area (64 m²) with the ARC system.

### Table 1. Yield, dry matter (DM) and Orchard gate Return (OGR) from Hyland’s Hort16A trial site

<table>
<thead>
<tr>
<th></th>
<th>Packed trays/ha</th>
<th>Count size</th>
<th>DM</th>
<th>TZG</th>
<th>Estimated OGR ($/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>15,579</td>
<td>30.4</td>
<td>17.4</td>
<td>0.48</td>
<td>68,100</td>
</tr>
<tr>
<td>High Production</td>
<td>17,417</td>
<td>29.4</td>
<td>18.1</td>
<td>0.61</td>
<td>85,200</td>
</tr>
</tbody>
</table>

**Significance:** NS = not significant * = Significant at P>0.05

1. Estimated from plot samples and packhouse reject data
2. Dry matter data based on April 18th samples.
KEY RESULTS

The HP plots produced slightly higher yields of higher dry matter fruit, which were more mature at the last sample date (Table 1 & 2). While neither fruit size nor yields were statistically significant (at P>0.05), we might expect the differences to be real based on other trials results. The estimated increase in Orchard Gate Return from the HP plots was $17,000/ha of which ~70 per cent of this increase can be directly attributed to a significant increase in Taste ZESPRI™ payments and the remainder to yield increases. Typically, commercial capital purchase of Extenday® would cost around $12,000/ha with a six to eight year lifespan reported. Artificial pollination as conducted here would cost another $3,500 to $4,500/ha suggesting a very good return on investment.

The crop was harvested earlier than expected on 24 April. Unfortunately harvest samples could not be collected so all results reported here are from the last sampling date on 18 April. Fruit from the HP and Control plots were commercially harvested, packed and stored separately so an assessment of differences in reject rate could be gained. Concerns over the potential increase in blemishes arising from leaf rub associated with the change in leaf angle seen with Extenday® use were not realized (Fig. 1). No differences in reject rates were seen (17.3 per cent and 16.4 per cent on Control and HP plots respectively). However all vines in this block were relatively well sheltered from the prevailing winds.

DRY MATTER

At the final sample date on 18 April, fruit DM was 17.4 and 18.1 per cent for the Control and HP vines, respectively. On a unit area basis, total dry weight production per m2 of canopy was 1.11 kg and 1.25 kg for the Control and HP vines, respectively, a 12.5 per cent increase. We cannot be sure whether this was a pollination effect, an Extenday® effect, or a combined effect. In future seed counts will be undertaken to assess whether seed set is increased with the artificial pollination. Separate trials are also been conducted to see if Extenday alone lifts DM as it does in Hayward.

ACKNOWLEDGEMENTS

We gratefully acknowledge both Don and Judy Hyland for the use of their orchard and who along with Russell Baker, provided valuable input into discussions around the project. We also thank Jonathan Toye and Craig Robertson from Extenday®, Steve Saunders and his team from PollenPlus® and Eastpack for their support. Lastly thanks to Mike Currie for his valued critiquing.

FURTHER READING.


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**Table 2. Maturity attributes of fruit from the Hyland Hort16A orchard trial. As recorded at April 18th sample date. Significance: * = significant (P>0.05)**

<table>
<thead>
<tr>
<th></th>
<th>DM (%)</th>
<th>Hue (°)</th>
<th>Brix (°)</th>
<th>Firmness (kg/f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>17.4</td>
<td>107.4</td>
<td>7.8</td>
<td>6.6</td>
</tr>
<tr>
<td>High Production</td>
<td>18.1</td>
<td>106.5</td>
<td>8.7</td>
<td>7.0</td>
</tr>
<tr>
<td>Significance</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

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2007/08 SEASON

This season, with improvements in leaf canopy management and the addition of a spring trunk girdle we expect to improve the productivity of the HP vines further. Such improvements may be even more feasible with the planned reduction in leader length and thus total canopy area from 64 to 48 m² per vine at this orchard. While attention to date has been on maximising productivity of fruiting vines, attention to the management of non-fruiting vines will also be required. Fruit size is already larger than the ZESPRI preferred crop profile so increasing the flowering potential of wood that has been grown on the “rested” vines will be essential in achieving further yield increases.
Compost tea has generated interest recently as a product with potential for improving plant health in a wide range of cropping systems. However, when applied to soil in organic kiwifruit orchards in each of three seasons, compost tea had no effect on fruit size, soluble sugars or dry matter. This study was funded by the MAF Sustainable Farming Fund, with contributions from ZESPRI, COKA and four kiwifruit packhouses.

**WHAT IS COMPOST TEA?**

Compost tea is a water-based extract of compost, produced by mixing compost with water and sometimes with additional microbial stimulants, before fermenting for one to seven days. The mixture is either allowed to stand with occasional stirring (non-aerated compost tea) or it is agitated continuously by injecting air during the fermentation process to enhance aerobic conditions (aerated compost tea). Aerated tea is more common in New Zealand and was used in this study. The extract is filtered to remove the coarse solid fraction prior to application to crop foliage (to control disease) or to soil (to improve root health and crop growth). The filtered tea retains soluble nutrients and other organic compounds from the compost as well as a population of micro-organisms comprising bacteria, fungi, protozoa and nematodes originating from the compost, but which may have multiplied during the fermentation process. This biological content is claimed as the key to the beneficial properties of compost tea. Compost tea is also known as compost extract or compost leachate. Vermicompost/vermicast (produced by worms) can be used with, or instead of, compost to make compost tea.

Interest in the use of compost tea among kiwifruit growers in New Zealand began around 2003, following seminars by Dr Elaine Ingham of The Soil Foodweb Institute, Oregon, USA. This institute promotes the importance of the soil foodweb to retain and recycle nutrients, build soil structure and promote a healthy environment for plant roots. At that time, compost tea was an unfamiliar term in New Zealand. However, after attending a seminar and obtaining a copy of *The Compost Tea Brewing Manual* (Ingham 2001), many growers were keen to try this new idea. Several compost tea manufacturers subsequently set up and began supplying kiwifruit growers. A Soil Foodweb laboratory and consultancy service, affiliated to the Soil Foodweb Institute, was also established in New Zealand.

Among kiwifruit growers, the attraction of compost tea was the promise of improved soil health at reasonable cost. Organic growers traditionally use compost to supply plant nutrients and maintain soil organic matter, but compost application at effective rates is expensive and laborious. To some, compost tea offered the benefits of compost without the need to spread a bulky product (although the Soil Foodweb message stresses the need for compost and does not claim that compost tea is a complete replacement). Consequently, many kiwifruit growers, especially those using organic production methods, began to use compost tea, or to show an interest in its use.

**STUDY DETAILS**

The study was conducted at eight sites (six ‘Hayward’ and two ‘Hort16A’) in the Bay of Plenty and Waikato over three seasons from 2004/05 to 2006/07 and was managed at each site by the orchardist, who chose the tea supplier and the frequency of application. The compost tea was applied to the soil beneath vines and not to the vine canopy (Figure 1). At each site, replicated plots were set up that either received or did not receive compost tea. A minimum of four applications per season were planned, but on average only two to three applications were actually applied over the study period. All other aspects of management of these plots were kept the same within each orchard.

Figure 1. Compost tea sprayer in operation in a kiwifruit orchard.
Each season, soil samples were taken and microbial measurements were carried out by the Soil Foodweb laboratory using visual counting methods, while soil, leaf and fruit nutrient concentrations were determined by Hill Laboratories Ltd. Packhouse staff measured fruit weight, soluble sugars (°Brix) and dry matter on fruit samples (n=90) collected prior to commercial harvest each season.

Increases in the density of soil fungi and bacteria were expected as a direct result of the compost tea applications, but none was found. The amount of active fungal biomass, an important parameter of soil health, varied widely among the study orchards, as well as from year to year, but did not show any consistent change as a result of compost tea application (Figure 2).

The reason for the dramatic drop in the fungal biomass values for the November 2006 sampling, confirmed by an additional sample taken in February 2007, is a mystery.

Other soil microbial parameters also showed no consistent effect in response to compost tea applications.

CONCLUSIONS

The results obtained demonstrate that use of compost tea formulations had no effect on organically grown kiwifruit orchards during the three seasons over which this trial was conducted. At the start of the study all participants, both orchardists and compost tea manufacturers were confident of positive results, so the lack of effect following three seasons trialling was not expected. The outcomes from the study need to be considered within the following context:

- The sites chosen for this study had BioGro certification and, in most cases, had a reasonably long history of good organic-based management, including relatively high inputs of organic matter and relatively low inputs of pesticides. These sites may in fact be near their biological optimum, and their soils probably already contain good populations and diversity of

Similarly, soil, leaf and fruit nutrients (nitrogen, phosphorus, potassium, etc.) showed no differences between the compost tea-treated plots and the untreated plots. Fruit parameters, including mean weight, soluble sugars and dry matter were also unaffected by compost tea application (Figure 3). Differences in mean fruit weight across seasons reflect sampling time relative to harvest, rather than growth differences.

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microorganisms. Consequently, the application of compost tea may have had no appreciable effect on the resident microbial population and thus no effect on the fruit parameters that were measured. It is possible to speculate that if the study had been conducted on biologically deficient sites, a different outcome might have been achieved.

- The crop used in the study (kiwifruit) is a perennial vine, with a large, deep permanent root system growing in fertile soils with relatively high organic matter content. It is possible that this system is so well buffered that any changes may take longer than three seasons to become evident. The number of applications of compost tea was in most cases fewer than planned. It is possible to speculate that if more applications had been made and if the study had continued for longer, changes in soil composition and fruit quality might have been achieved. Good results have been claimed (anecdotally) for compost tea in pasture and annual crops, where less root zone buffering exists, compared with kiwifruit.

- The quality of compost teas used in this study may not yet be optimised for kiwifruit. Compost tea production is fairly novel in New Zealand. With no historical experience to draw on, manufacturers are feeling their way, making changes to their processes and using Soil Foodweb laboratory test results to improve their compost teas by trial and error. Compost tea is a biological product and is subject to a huge array of variables, so it is to be expected that gaining quality improvement along with consistency of product will be a slow process. Feedback from clients using compost tea with success will assist product improvement. It is possible to speculate that if this study were to be conducted in five or ten years’ time, when tea quality and consistency has improved, a more positive outcome may be achieved.

REFERENCE

On some Hayward orchards, shoot growth during summer may be vigorous, so some orchardists control this by frequent summer pruning. This results in high pruning costs and competition from the consequential regrowths may reduce fruit size and fruit dry matter content.

As part of a Kiwifruit Royalty Investment Project we are measuring what factors control the distribution of growth in Hayward kiwifruit vines. As an industry, we need to find ways of manipulating vines so that fruit growth is maximised, and unwanted vegetative growth is kept to a minimum. Some years ago, one grower remarked, “the Bay of Plenty is ideal for growing kiwifruit leaves, the fruit come second”.

Figure 1. In some Hayward orchards, vigorous shoot growth during summer makes vine management expensive - but does it also reduce fruit dry matter content?

Figure 2. On some shoots, regrowth was allowed to develop. We stripped the leaves from the regrowth every week to ensure that they never developed enough to contribute to fruit growth. Note the girdle at the base of the shoot, to isolate the experimental shoot from the rest of the plant.

Kiwifruit Plants
(2008 Season)

HAYWARD
Kramer female, Chieftain male

BRUNO ROOTSTOCK
1st and 2nd year

All plants excellent quality

Alpha Nurseries
KATIKATI

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Phone 021 024 23475
During flowering in 2006, we selected a number of shoots and pruned them to stimulate regrowth. After fruit set we set fruit and leaf numbers to:

- four leaves + one fruit
- four leaves + one fruit + one regrowth
- four leaves + one regrowth.

All shoots were girdled so that only the leaves on the shoot could support the growth of fruit or regrowths on their shoot. Regrowths were left on all shoots until mid January when they were about 20 cm long. At this stage we removed all regrowths except those we wanted to retain. From this time onward we stripped the leaves off regrowths as the leaves expanded (Figure 2). This allowed us to measure how much of the resources being produced by the shoots was required to support elongation of regrowths. Of course in a normal orchard situation, elongation of regrowth would be supported by carbohydrate from the parent shoot for the first few weeks only: as the

![Figure 2](image)

**Figure 2.** During January and February, elongating regrowths were allowed to compete with fruit for carbohydrate and this reduced fruit growth by 48 per cent (top graph). The presence of a fruit did reduce elongation of regrowths, but only by 17 per cent.

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regrowth developed larger leaves, these would return carbohydrate to the shoot and this should increase fruit growth. For this trial we wanted to make sure the regrowth was always acting as a competitor to fruit. This should give us an indication of what happens during the first flush of regrowth on commercial orchards.

We found that while regrowths were vigorously elongating, fruit growth was dramatically reduced (Figure 3). Once the regrowths stopped elongating, then fruit growth was actually faster than on the shoots with no regrowths. We also found that producing a regrowth uses about the same amount of resources as growing a fruit. By harvest, the total dry matter (DM) in fruit was 20.1g, while regrowths contained 26.2g DM. At harvest, fruit supported by four leaves were large, with an average fresh weight of 151g and DM content of 17.2 per cent. Competition from a single regrowth reduced average fruit fresh weight to 130g and DM content to 15.9 per cent. That is, regrowth resulted in a loss of 21g in the fruit weight and a loss of 1.3 per cent DM.

WHAT DOES IT MEAN?

We measured the competition between fruit and shoots under simplified, artificial conditions, so our data cannot be applied directly to commercial orchards. However, our test system showed that summer regrowths can dramatically reduce both fresh weight and DM accumulation in fruit during the first few weeks of growth. In orchards where there are many cycles of vegetative flushes followed by pruning, this may appreciably reduce fruit size and fruit quality.

This confirms recent research (Patterson et al. 2007) where it was shown that orchards that do not need summer pruning produce fruit with a higher DM. It may also explain why warm summers in the Bay of Plenty tend to lower per cent DM (Snelgar et al. 2007), since we know that higher temperatures greatly increase the rate of vegetative growth.

This season we will carry out similar trials, but we will leave the leaves on some regrowths so that we can measure when shoot regrowth stops reducing fruit growth and when it resumes supporting fruit growth.

REFERENCES


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INTRODUCTION

Nitrogen (N) is an essential plant nutrient and is generally applied at relatively high rates in kiwifruit compared with other perennial horticultural crops. High levels of plant-available N encourage strong vegetative growth and may impair fruit quality in kiwifruit. This, coupled with the potential increase in leaching losses under a high N loading, justifies the need for research to improve our understanding of how N can be managed for maximum benefit without environmental compromise.

Since June 2004, the Sustainable Land Use Team from HortResearch has carried out field experiments on a high-producing Hort16A property in the Te Puke region. The research is funded by the Sustainable Farming Fund (SFF) administered by MAF, and it has focused on the impact of either increased, or reduced, application of N on the nitrogen economy of the vines. Treatments were based on the grower’s current rates of fertiliser use, with Control being equivalent to approximately 145kg N/ha/y, Zero-N had no additional inputs of N fertiliser, and High-N had twice the current commercial rate (approximately 295kg N/ha/y). All other nutrients were applied at current commercial levels. A detailed description of the SFF trial can be found in the May/June 2007 edition of the New Zealand Kiwifruit Journal (Mills et al. 2007).

Table 1 outlines application of all other elements over the three years of the trial. During the three-year trial period, the Zero-N treatment vines showed reduced leaf and fruit N levels compared with both Control and High-N vines. The Zero-N treatment had significantly reduced vegetative growth every year, yet fruit size was reduced (by cf. 10g) in just one year, and that was only when compared with the High-N treatment. Despite having no N fertiliser applied for three seasons, and consistently high cropping levels (16,000-17,000 trays per ha) which we may expect would deplete soil reserves, the Zero-N vines continued to perform well. Fruit set for the 2007-2008 season was similar between all three treatments.

The deep pumice-derived ash soil at the trial site has the potential to provide significant amounts of plant-available N (Mills et al. 2007). Indeed, the reserves of mineral N were such that the Zero-N vines retained their reproductive capacity (i.e. return bloom, fruit size) albeit with a reduction in vegetative growth. Results from our field trials suggest that although the total mineral N content in the soil is much lower in the Zero-N vines cf. the High-N vines, a large amount of N is still available to the vines, through mineralisation of soil organic matter which releases plant available mineral N from the organic N pool.

Are you making the most of the Nitrogen available in your soil?

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3 Palmerston North Girls High School, Fitzherbert Avenue, Palmerston North

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**Table 1.** The application of all other elements during the 3 years of this trial.

<table>
<thead>
<tr>
<th>Product applied</th>
<th>Kg/ha 2004</th>
<th>Kg/ha 2005</th>
<th>Kg/ha 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lime</td>
<td>1250</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Muriate of potash</td>
<td>250</td>
<td>154</td>
<td>150</td>
</tr>
<tr>
<td>Sulphate of potash</td>
<td>725</td>
<td>761</td>
<td>756</td>
</tr>
<tr>
<td>Cal mag</td>
<td>192</td>
<td>173</td>
<td></td>
</tr>
<tr>
<td>Super phosphate</td>
<td>250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triple super phosphate</td>
<td></td>
<td>300</td>
<td>225</td>
</tr>
<tr>
<td>Ferrous sulphate</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Granular boron</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Calcium ammonium nitrate</td>
<td></td>
<td>415</td>
<td>477</td>
</tr>
<tr>
<td>Kieserite</td>
<td>225</td>
<td></td>
<td>190</td>
</tr>
<tr>
<td>Nitrob</td>
<td>174</td>
<td>155</td>
<td>150</td>
</tr>
<tr>
<td>Gypsum</td>
<td></td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Dolomite</td>
<td></td>
<td></td>
<td>500</td>
</tr>
<tr>
<td>Compost</td>
<td></td>
<td></td>
<td>5000</td>
</tr>
</tbody>
</table>

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There are two forms of nitrogen in soil: organic nitrogen that resides in the soil’s biomass, and mineral nitrogen (i.e. ammonium and nitrate) that is either dissolved in soil water or absorbed to the soil’s mineral particles. At any given time only a small portion of the soil’s total pool of nitrogen is available for plant uptake. Typically, the dissolved mineral-N accounts for one to three per cent of the soil’s total N. Mineral N can be absorbed by the plant roots, but only when it is in solution.

Mineralisation of organic N to ammonium, and subsequent hydrolysis to nitrate (the two forms of mineral-N that plants readily take up) is dependent on both soil temperature and moisture content. The process of mineralisation is reduced under cool and/or dry conditions. Conversely, waterlogging causes nitrate to be reduced to nitrite, nitrous oxide or molecular nitrogen. None of these forms of N can be utilised by plants and they may even be volatilised from the soil. This net loss of N occurs when the soil is close to saturation, and is termed denitrification.

Nitrate-nitrogen which is highly mobile within the soil may also be lost through leaching following heavy rainfall or excessive irrigation. The loss of nitrate through leaching is of environmental concern for it poses a contamination risk to ground and surface water. Our estimates suggest that mineralisation rates over the three trial years at the SFF site were up to 100 kg-N/ha each year.

Effective N management needs to account for mineralisation processes that occur within the soil. To help quantify these N inputs, HortResearch staff have evaluated potential mineralisation rates in five contrasting kiwifruit soils and two wine grape soils. The experiments were done in the laboratory under optimum moisture and temperature conditions. Laboratory results are compared with mineralisation data obtained from the SFF trial site (referred to as Te Puke 1; Table 2) and the other kiwifruit soils. These results enable us to make a relative assessment of the potential contribution of mineralisation to the nitrogen budget of vines growing on some key kiwifruit soils. With such data we are also able to compare mineralisation rates in kiwifruit orchards and grape vineyards.

Kiwifruit are normally grown on high-fertility soils whereas more impoverished soils with both physical and nutritional limitations are favoured for grape production. Table 2 lists the soil series and the corresponding carbon (C) and N contents of the soils that were studied.

**SOIL ANALYSES FOR MINERAL N**

Our assessment of soil mineral N was undertaken in the laboratory. In each case a 10kg sample of field-moist soil was taken from the top 15cm of soil. Samples were obtained from the SFF trial site and from seven additional sites (three x Bay of Plenty, one x Northland and one x Nelson, currently growing kiwifruit, and two x Hawke’s Bay soils currently growing wine grapes). Each sample was sieved to two mm, and the moisture content was adjusted to 80 per cent of field capacity. The samples were then placed in sealed containers at a temperature of 20°C.

Throughout the incubation period, the soils were regularly sampled to determine the concentration of mineral N following extraction.
with Potassium Chloride (2M KCl). This laboratory analysis provides a relatively rapid assessment of the potential delivery of mineral N under non-limiting (optimum) conditions, which would be difficult to manage in situ. We are also able to compare relative mineralisation rates between different soils.

Laboratory data from this study were also used to cross-check the mineralisation routines of SPASMO, a Soil Plant Atmosphere Model developed by HortResearch to predict the environmental impacts of land-use activity. The model includes a calculation of crop water use and N leaching from productive soils. In SPASMO, the key drivers of N mineralisation are soil moisture, temperature and organic matter content. The soil’s organic matter is divided into two pools— a fast cycling litter pool and a more stable humus pool. The fast cycling or labile pool of organic nitrogen is smaller (one to three per cent of the total organic N) and provides the source of mineral N as it decomposes.

RESULTS AND DISCUSSION

Mineralisation data from the SFF trial site (Te Puke 1) are presented in Figure 1. The initial mineral N content of the soil was about 75mg/kg. After four months of incubation at 15C the mineral N content had risen to ~200 mg/kg, and it reached almost 300 mg/kg after 450 days. Changing soil temperature by +10C approximately doubled the mineralisation rates while reducing soil temperature by 10C effectively halved the release of mineral-N. We see a
cumulative increase in the mineral N content of the soil, noting that there are no plant roots, or leaching processes to remove N from the soil sample. In the field the mineral N content of the soil is expected to be much more dynamic, with continuous inputs and losses occurring from the soil.

The mineral N content of the other soils has also been evaluated in incubation experiments, and modelled using SPASMO (Figure 2). These soils were evaluated for up to 60 days (Bay of Plenty (BOP) x two (Opotiki and Katikati), Northland x one (Kerikeri), Hawke’s Bay x two (Omahu and Poporangi)) or 118 days (one x BOP (Te Puke two), one x Nelson). Interestingly, we observed similar mineralisation rates from all the kiwifruit orchard soils (solid lines and symbols), and they were consistently higher compared with the two vineyard soils (open symbols and dashed line).

The total mineral N present at day zero is marginally different among soils. These differences are predominantly due to differences in the labile (readily degraded) fraction of the soils organic matter. Soils with higher levels of labile carbon are capable of delivering more mineral N to the soil system, all other factors being equal. In contrast, mineralisation rates from the vineyard soils are markedly lower. The Omahu soil is a shallow gravely sand with low organic matter that produces low-vigour vines that typically have small berries with intense flavour. The Omahu soil form part of the Gimblett Gravels wine growing region, near Hastings, that has become synonymous with high quality wine grape production. In contrast, the Poporangi soil is more fertile (shown at the top of Figure 2) as shown by the higher initial mineral-N content of the soil. Grapevines on the Poporangi soil tend to be more vigorous (cf. vines on Omahu soil), although the greater vegetative vigour may reduce wine grape quality.

In the case of the Omahu vineyard soil, all stones larger than two mm were also removed (noting these accounted for 65 per cent V/V of the soil profile). Because of the high stone fraction in this soil in situ, the rate of mineralisation presented here, for the fine-earth fraction, is much higher than would otherwise occur naturally in the field under optimum moisture and temperature.

Low rainfall in the Hawkes Bay over the summer period means both the Poporangi and the Omahu soils have periodic moisture limitations that will reduce the actual mineralisation rates. This contrasts with many of the soils from the Bay of Plenty region, which are typically deep and free draining with regular rainfall. Increasing use of irrigation will help maintain these soils at close to optimum moisture conditions for N mineralisation.

CONCLUSIONS

Under ideal conditions in the laboratory, the rate of N mineralisation is maximised and we are able to determine the soil’s potential to deliver plant-available nitrogen from the soil’s reserves of organic nitrogen. Because moisture and temperature are optimised in these measurements, we expect that in situ values of mineral N would be less than these reported here. The initial mineral N content of the kiwifruit orchard soils ranged between 10 and 35kg N/ha, as calculated for the top 15cm of the soil. The initial mineral N content of soil from the SFF trial site was higher (at about 75kg N/ha) compared with the other Bay of Plenty soils (which ranged between 30-50kg N/ha). For the purpose of calculation we have assumed a soil bulk density of 1.0kg/L, although we recognise that most pumice-derived volcanic soils have a bulk density between 0.85 and 1.0kg/L.

Following 60 days of incubation at 20°C, the equivalent of an additional 50 to 75kg / ha of N is released from the soil via mineralisation. All soils from the kiwifruit orchards showed similar rates of mineralisation, as evidenced by the parallel lines from Figure 2. Differences in mineral N contents after 60 days are largely explained by the different initial mineral N contents which are dependent on the labile carbon content of the soil. Overall, our results show that soils from kiwifruit orchards have a high potential to deliver significant levels of mineral N. It is important to consider the implications of soil-N mineralisation in combination with the application of N fertiliser under high rainfall and on the free draining soils of the Bay of Plenty region.

Nitrate-nitrogen is readily-soluble. It is also highly-mobile and will move downwards through the soil profile, as a passenger chemical that travels with the drainage water that quits the root-zone. Timing of N application is therefore critical if wastage is
to be avoided (Clark & Ledgard 1993), especially following large rainfall events. High applications of N fertiliser in the springtime may be inefficient both because of low rates of root uptake activity combined with soils close to field capacity which encourages N leaching. The increasing use of irrigation on more drought-prone shallow soils of the eastern BOP makes a more considered N management strategy critical to reduce the risk of N leaching.

The SFF trial has shown that under the High-N treatment, the time to reach fruit maturity appears to be delayed as measured by dry-matter content (DM) and fruit flesh colour. We have found that current N application on most kiwifruit properties is higher than can be accounted for in the harvested fruit. This, coupled with N mineralisation from the soil, could lead to an excess supply of plant-available nitrogen that simply encourages vegetative growth at the expense of fruit growth. It is possible that reduced N application might not only reduce kiwifruit vigour, but may also encourage some improvements in fruit quality both at harvest and during storage. Results from the SFF trial showed a continued high performance from those vines where N fertilisers were withheld for three years.

The ability of the Zero-N vines to maintain their productivity was primarily due to the large amount of N being mineralised from the soil’s reserves. Our trial results suggest an application rate of between 80-100 kg N/ha would be sufficient to meet the plants needs at the experimental site (Te Puke 1, Te Puke sandy loam) given that N removal in the fruit was between 80-120kg N/ha per year, on average. Values of 150kg N/ha/y was removed in the fruit of the High-N treatment in year three. Slightly higher N rates may be justified on other Bay of Plenty soils that exhibit lower N mineralisation potential compared with the soil from the SFF trial site. However, our laboratory data indicates that all the kiwifruit orchard soils had a similar high potential to deliver mineral N. Nitrogen mineralisation is an important component of the N budget. Orchardists considering reductions in N use should also consider possible gains from increased N uptake from split applications and regular leaf nutrient analysis to monitor N uptake.

These data provide an opportunity to predict, using SPASMO (a research tool developed by HortResearch), likely delivery of plant available N in kiwifruit soils given conditions of soil moisture and temperature. Soil temperatures in the BOP region between September and May range from a minimum of 10°C in May and a maximum of 20°C during January and February. The incubation and analysis of these soils is ongoing and will continue through to at least 220 days. This will allow more model validation and better predictions in future.

ACKNOWLEDGEMENTS

Funding for this study was provided by the Sustainable Farming Fund (SFF, administered by MAF). Researchers would also like to thank John May for the continued access to his orchard and his help maintaining the trail over the course of this study.

REFERENCES

A survey of industry participants indicated there is a very strong reliance on foreigners to make up the seasonal workforce in the kiwifruit industry. Seven out of the ten participants in this survey believed that their seasonal staffing practices would significantly change under the Recognised Seasonal Employer (RSE) and five are planning to recruit staff through the RSE scheme.

Low unemployment and skill shortages have caused many seasonal employers in New Zealand to look to foreigners (backpackers and temporary migrants) to fill their seasonal positions. The New Zealand Government has recently passed legislation, the Recognised Seasonal Employer (RSE) Scheme, which will allow 5000 temporary migrants from the Pacific Islands to work as seasonal labourers to help alleviate these labour shortages. This research was focused on gaining an understanding of employers’ seasonal staffing practices in the kiwifruit industry and how these employers perceived these may change under the RSE legislation. This was broken down into:

1. How are foreigners perceived as workers?
2. How will the RSE legislation affect seasonal staffing practices?
3. How do different stakeholders in the kiwifruit industry feel about the new legislative changes?

Ten participants were recruited and interviewed from small and large businesses in the Te Puke area, to glean whether seasonal staffing practices and opinions of the RSE differ according to the size and type of business (see Table 1 for a breakdown of the participants). The interviews took place in August 2007.

### KEY FINDINGS

#### THE PERCEPTION OF FOREIGN WORKERS

Overall it was found that there was a very strong reliance on foreigners to make up the seasonal workforce in the kiwifruit industry. All the participants had used foreign workers to supplement their workforce over the peak periods this year and in the past. The results from the interviews indicated that backpackers made up at least 50 per cent of their seasonal workforce (for harvesting) and were the most popular type of worker used over this period. The origins of backpackers ranged from Japan, Canada and Argentina but the most prevalent were from Brazil, the Czech Republic and Western Europe. The majority of these backpackers were on working holiday maker visas and many of the others were on Seasonal Work Permits (SWPs). Many acknowledged that they now have no other option but to hire foreign workers due to low unemployment in the area and throughout New Zealand. Other participants noted that they purposely targeted backpackers and preferred them to local workers.

The perceptions of backpackers as workers were overall very positive. A typical comment was that they are “reliable, smart, university qualified, willing workers, keen to learn and listen…” One participant indicated that backpackers were a lot less hassle to manage compared to migrant workers, under the strict requirements of the Approval in Principle and RSE legislation. The only disadvantages that participants saw with hiring backpackers was that they “stayed only for the season.”

The major benefit that employers associated with hiring migrant workers is that they are a stable and committed workforce. There was no consensus from participants on how Pacific Islanders were viewed as workers. Three interviewees (growers and contractors) believed that they were unreliable and their work ethic was completely different to New Zealanders. While others (five participants) believed that they “had good ethics [and] strong values…” and were not motivated solely by money. Two participants had heard “mixed

<table>
<thead>
<tr>
<th>Type of Business</th>
<th>Number that participated</th>
<th>Applying for RSE Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orchardist</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Contractor</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Packhouse (HR Managers)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Orchardist / Contractor</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Industry Associate</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

Resolving labour shortages – Is RSE a step in the right direction?

Sophia Max, Victoria University, Wellington
stories of how good Islanders are as workers.” An interesting finding was that none of the participants thought that language barriers were a major problem with workers from non-English speaking countries. Overall participants stated that language barriers were minor and employers and managers had found ways to work around any communication or language problems. As these findings indicate, there is no clear consensus but overall the comments about both backpackers and migrant workers are positive and encouraging.

**RSE AFFECTING STAFFING PRACTICES**

Seven out of the ten participants believed that their seasonal staffing practices would significantly change under the new legislation. These participants indicated that their practices would change in terms of recruiting staff (Table 2) and the benefits that they would have to provide staff with. Five of the employers (one grower, two contractors and both packhouses) are planning to recruit staff through the RSE scheme. The number of workers that these companies are applying for under the RSE ranges from 6 to 949 workers and from countries like Vanuatu, Solomon Islands and Indonesia. This means that recruitment practices for many companies will become more formal and proactive as the process to apply for workers under the RSE scheme is long and requires planning. This also means that these employers will rely less on working holiday makers. The other four employers that are not planning to apply to the RSE and will continue to rely on their good reputations and working holiday makers to fill their seasonal vacancies.

Currently most employers provide the minimum remuneration that is required. Out of the nine companies, only four employers paid workers according to their skills and experience. Others benefits such as accommodation and transport were provided by four employers and two of these were due to AIP requirements. As five participants plan to get RSE status, the benefits they provide to workers will be far greater in the future. Accommodation and transportation must be provided, plus employers are responsible for paying half of the worker’s airfare. Providing suitable accommodation was seen as the biggest change and challenge for employers. There is already a shortage of seasonal and affordable accommodation in the Te Puke area. Four of the five were planning on using hostel accommodation and/or home stays with locals in Te Puke to house their RSE workers. The other employer applying for RSE was planning to buy land and build accommodation for his RSE workers. All of these participants noted that their responsibilities and costs would increase significantly under RSE. This shows that RSE clearly splits the participants in two groups, those that are applying for RSE and those who are not. The latter group feel they will not have to change their recruitment practices or employee benefits to attract workers in the future (mostly backpackers). However the first group will need to make significant changes to attract and reward workers in order to comply with RSE requirements. The most crucial change will be a formalised and strategic approach to recruiting and managing their seasonal workforce.

<table>
<thead>
<tr>
<th>Recruitment Method</th>
<th>Number of participants that use this method (Maximum of 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word of Mouth/ Reputation</td>
<td>7</td>
</tr>
<tr>
<td>Formal Advertising (billboards, newspaper, radio, etc)</td>
<td>5</td>
</tr>
<tr>
<td>Seasonal Labour Coordinator</td>
<td>4</td>
</tr>
<tr>
<td>Informal Advertising (sandwich board on the road, and flyers)</td>
<td>3</td>
</tr>
<tr>
<td>Approval in Principle</td>
<td>2</td>
</tr>
<tr>
<td>Contractor</td>
<td>2</td>
</tr>
<tr>
<td>WINZ</td>
<td>2</td>
</tr>
<tr>
<td>Through Backpacker Accommodation</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2: Current Recruitment Methods Used By Employers

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PERCEPTION OF THE RSE

POSITIVES

The consensus (nine of 10 participants) agreed that the RSE was a step in the right direction but all of the participants had concerns with aspects of the legislation. A typical comment regarding the RSE was “I think that the RSE is a good idea but it has missed the boat.” Most participants were taking a hesitant and cautious approach to the legislative changes. All participants deemed that the legislation had aspects that were beneficial for their company and/or the industry. Employers viewed getting a seasonal workforce that would return year after year, that they had previously trained, as positive. Participants also noted that they would have access to more workers and would have a stable and reliable workforce that would stay with them throughout the season.

CONCERNS

The participants had a number of concerns regarding the RSE legislation and comments regarding the “prescriptive and cumbersome” nature of the legislation were frequent. There were four common themes that shone through regarding the new legislation. These were the restrictions on the number of workers, no SWPs, the political nature of the legislation, and the cultural differences between New Zealand and the Pacific Islands.

Firstly, the limit of 5000 workers that could be brought out under the RSE was seen to be insufficient and three participants stated that it needed to be extended to 10,000 workers. As many big employers were applying for large numbers of workers (one packhouse was applying for 949 workers alone), the participants could not comprehend how 5,000 were going to suffice not only for the kiwifruit industry, but for the whole horticulture industry.

Secondly, over half of the participants were critical of the requirements that workers had to come from certain countries in the Pacific Islands. Five employers thought that it should be open to any country and the government was using the horticulture industry to fulfill their commitment to the Pacific Islands, as indicated in the following quote - “it is a political decision not an industry decision.” Two participants commented that they would like to get their workers from countries like India and Fiji, as they had current staff members from these countries and they had experience managing workers from these cultures. As these countries were not RSE approved countries, they were unable to do so. The majority of participants thought that the reason for workers to come from the Pacific Islands was “purely political.”

Thirdly, seven of the participants expressed concerns with workers from the Pacific Islanders adapting to the New Zealand culture and that there may be negative social repercussions both in New Zealand and in the Pacific Islands. Repatriation (ensuring the worker returns to their home country) was the major concern (as employers are fined $5,000 for any employees that overstay their visa). Seven participants thought this fine was too steep and the legislation needed to be changed. Many suggested alternatives like setting up a trust into which part of the migrant workers earnings would go and would only be released to them when they returned home, or having support networks in place to ensure they return to the Pacific Islands. Other cultural differences employers perceived as potentially problematic were adjustments to New Zealand’s lifestyle and climate. Work ethic was also seen as a potential problem due to Pacific Islanders running on “island time” and high levels of unemployment in some of the Pacific Islands.

Lastly, employers (especially contractors) were worried about the loss of the SWPs and the lack of an appropriate replacement. Three of the participants thought that SWPs needed to be reinstated or a similar arrangement put in place. Often there are periods in which the need for staff increases and in the past, SWPs have covered these peaks. Participants expressed concern that in “short peaks”

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<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>Workers that would return year after year</td>
<td>The restriction on the number of workers brought out under the RSE</td>
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<tr>
<td>A stable and reliable workforce</td>
<td>The removal of the Seasonal Work Permits</td>
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<td></td>
<td>Political nature of the RSE legislation</td>
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<tr>
<td></td>
<td>Cultural differences between New Zealand and Pacific Islands</td>
</tr>
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the only available option will be working holiday makers and that there will not be enough of these workers to meet the demand.

It was interesting to note that many participants thought that the answer to reducing the seasonal labour shortage was not recruiting and attracting more workers to the area. Three of the participants noted that better workplace practices are needed, and that the focus should be on effectiveness and efficiency rather than cutting costs. Technology and innovation were seen by four participants as playing a role in the future, especially in packhouses. Streamlining work practices and technological advances can help to reduce the number of workers needed and therefore reduce the severity of the seasonal labour shortage. Although, as one grower summed it up, “there is no incentive at the moment to use technology due to the low price of labour.”

CONCLUSION

The study found that there was a high reliance on backpackers and migrants not only during harvest season but also year round. This is a clear indication of how severe the labour shortage is. These results support the literature that foreign workers make up a significant portion of the workforce, especially in areas that are experiencing skill or labour shortages. The overall perception of the RSE is that it is a step in the right direction but it has some problems which need to be addressed. While the concern that the RSE legislation will increase costs and responsibilities for employers is justified, employers can no longer expect workers to come to them, with the low levels of unemployment and high skill shortages that New Zealand is currently experiencing. A combination of a good reputation as an organisation and long term strategic planning is needed to attract both local and foreign staff. As one of the participants put it “this is a wakeup call for the industry.” Times have changed and the industry must move forward.

ACKNOWLEDGEMENTS

The author wishes to thank all those who willingly gave up their time to participate in this study. Also Chris Gazley, Shane Max and Todd Bridgman. This project was undertaken as a requirement for the completion of Bachelor of Commerce and Administration Honours (BCA Hons) at Victoria University.
MARKET PERFORMANCE STRONG

ZESPRI™ ORGANIC Kiwifruit performed rather well in the markets this season and if it wasn’t for the stubbornly high New Zealand dollar, grower returns would have looked considerably better. All categories had volume increases but organics certainly had their work cut out with a massive 25 per cent increase in volume and a considerably smaller size profile over 2006.

PRICE PREMIUMS ACHIEVED

ZESPRI™ ORGANIC continues to receive price premiums in all markets. Taking account of the smaller profile, organic price premiums over conventional ranged from 13 per cent in Japan, 18 per cent in Europe, 30 per cent in Korea and to 50 per cent in the US. ZESPRI’s ORGANIC category manager Tom McLaughlin said he was very pleased with the premiums. “Our markets have worked hard for these premiums. ZESPRI™ Kiwifruit is already priced at a premium so it's a tough task to convince customers to pay an additional premium for ZESPRI™ ORGANIC.”

TRADITIONAL EUROPEAN MARKETS SHINE

Europe got off to a flying start in 2007 with 60,000 TE’s shipped in week 15, a record early organic shipment to this destination.

“The early shipment to Europe meant 60,000 trays were sold at the beginning and not at the end of the season where extra costs are incurred.

“It was an excellent start and one we must repeat in 2008 to secure that early shelf space,” says Tom.
The decisions you make now can affect the operations of your orchard. Take the guesswork out of the weather – having access to detailed and accurate weather information will guide you with your decision making.

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pleased" with growth in all markets including countries such as Sweden where retailers are coming back to organics after exiting two years ago due to stiff competition from the hard discounters.

Strong distribution across all countries plus close monitoring of retail accounts, particularly the large accounts of Edeka in Germany and Colruyt in Belgium, was key, according to Tom, in moving the additional crop while minimising negative impacts on price.

**ORGANIC RETAIL PROMOTION BELGIUM**

It was a superior year for organic taste in 2007 with GREEN ORGANIC average dry matter (DM) 17.0 and GOLD ORGANIC a stunning 18.9. Japan received 90 per cent Y band, up from 70 per cent in 2006, and the customers have noticed and taken action. JAPRO’s President Abe-san reports part of the reason for his company’s increased sales was the higher dry matter along with consistent delivery of product: “Very good taste, much better than last season” reported Abe-san.

This was a great result said Tom “Our Deputy General Manager in Japan Ebihara-san and the marketing team have worked very hard and produced an excellent result which included a 13 per cent price premium. Organic growers also need to be congratulated for understanding the importance of taste and delivering a good product to the market.”

**KOREAN KNOCK-BACK FORCES STRONG RESULT**

Korean ORGANIC sales volumes were down in 2007 due to the tough quarantine laws which included a zero scale tolerance. GREEN ORGANIC was 10 per cent lower while GOLD was back a significant 80 per cent.

ZESPRI Korea Market Manager, Dan Mathieson, and the ZESPRI Korean sales and marketing managers implemented market strategies to mitigated the potential downsides.

“Korea pulled off an excellent result making the most of the shorter crop at beginning of the season,” said Tom.

ZESPRI is working closely with HortResearch to ensure improved market access for organic produce to Korea in 2008.

**THE GOOD AND THE UGLY FROM NORTH AMERICA**

The United States produced good news and bad in 2007. ZESPRI took a bold decision and doubled the organic volume into North America in 2007 based on positive demand feedback from key customers. And while the early signs were positive this created problems later on.

“In hindsight we shipped too much too early which resulted in a higher fruit loss mid-season,” reported Tom. “Our two dedicated distributors, Oppenheimer and Farmers Fruit Express, are aware of this problem and will work to a new plan in 2008.”

ZESPRI North American Market Manager Karen Brux is experienced and committed to continue to explore organic sales opportunities going into 2008.

Tom attended the Produce Marketing Association (PMA) trade fair in October.

“I met with a number of customers including Wholefoods buyers,” he said. “Wholefoods, with over 300 stores, is the largest organic retailer in the world. They’re really excited about ZESPRI™ ORGANIC and want to increase their business with us, particularly GOLD ORGANIC, but also GREEN”.

The recent market access scare to the US demonstrated how vulnerable exporters are to foreign agencies changing their minds on access conditions. The United States Department of Agriculture (USDA) has reversed its decision on certain materials and Excel Oil and D-c Tron are again accepted for use on organic product imported into the United States.

“It was great to see ZESPRI, BioGro and the NZ Food Safety Authority working together to put the NZ case to the USDA,” said Tom.

**EAST AND SOUTH EAST ASIA SHOWS PROMISE**

New organic stores such as 360 in Hong Kong and a greater awareness of eating healthy food is pushing organic demand in this region according to market manager Kelvin Bezuidenhout. “Sales doubled in Singapore and Hong Kong this year, and while the
volumes are small, the signs are encouraging for further growth in the New Year.”

HIGH NZ DOLLAR DAMPENS GROWER RETURNS

After reading the positive comments above you may begin to wonder why the performance is not reflected in the growers’ bottom line and Tom clearly points the finger in one direction, the exchange rate.

“In 2007 the NZ dollar appreciated 15 per cent against the US and a whopping 20 per cent against the YEN over the 2006 season. It makes life very difficult when faced with that kind of movement. The organic category lost approximately 80 cents per tray due to the appreciating New Zealand dollar.”

LOOKING TO THE FUTURE

The 2007 season produced a large crop but there is additional organic volume coming on stream with at least 100 hectares in conversion to GREEN ORGANIC. Tom acknowledges that ZESPRI will need to continue to push market growth but he has a very profound message on how to manage this: “keep it simple”.

“Organics is a premium priced product. Delivering product in full, on time and specification is even more important for this category. At the prices we command you cannot cut corners in organics. Retailers won’t stand for it. They will opt for competitor products which offer better margins.”

Tom cites robust certification along with growing a good size product (average 35 or larger) and chasing taste as other important requirements for securing a strong, profitable, organic future.

“Consumers remain nervous about product claims so don’t underestimate the importance of a water tight and genuine organic certification system.”

Finally, the organic category must keep an eye on the conversion product.

“You can’t flood the market and expect the same premiums. Go for gentle growth and keep the market informed. The total organic market is growing, but it’s off a small base, just two per cent of global market share. The number one reason consumers don’t buy organics is price; we must continue to be realistic and ensure orderly growth with sensible premiums to match the future demand.”

TOM’S DEPARTURE

“Organics to me is about people, passion and the product. It’s easy to enjoy your work when you are surrounded by positive, passionate people, as I have found both organic growers and customers to be.”

“Organic growers are very keen to progress, trying new things all the time. I find them very enthusiastic and that just rubs off on your own mood.”

“Thanks very much to COKA Chairman Jim Matthews, and previous Chair Leo Whittle, to Tim Oliver and the rest of the COKA Exec and Advisory Group. Organic growers are really fortunate to have such committed people representing their category. To all of you, thank you, you have truly made my time at ZESPRI very enjoyable, it has been a privilege.”

Editor’s note

Tom leaves for pastures new after 16 years with ZESPRI. We wish him well in his future endeavours.
Who likes a sweet fruit that has no “zing”? Or eating lemons? Great kiwifruit flavour comes from balancing sweetness with acidity. Consumers consistently rate flavour as one of the most important reasons for buying a particular fruit, influencing market demand and therefore grower revenue. In this article, we examine accumulation of acids in kiwifruit and consider how climate, management techniques and storage modify the acidity and final flavour of kiwifruit.

**COMPOSITION OF KIWIFRUIT**

Producing kiwifruit with flavour superior to that of our competitors’ fruit is the basis of the successful Taste ZESPRI™ marketing programme. Kiwifruit flavour is closely approximated by the fruit dry matter content (DM) (Harker 2004). Fruit DM is the sum of the components that remain after the fruit are dried to remove the water. It is made up predominantly of sugars and acids, with lesser amounts of protein, pectin, fibre, vitamins (largely A and C) and minerals. However, the amount of each component can vary; for example, the acid content of ripe fresh fruit can range between 0.9 and 2.0 per cent titratable acidity (TA). The two main acids found in kiwifruit are citric and quinic acid, each at around 40-50 per cent of the total acids, with lesser amounts of malic acid (10 per cent). The effect of each acid on the acidity of the fruit can vary, with citric being the most acidic and quinic the least.

**FLAVOUR OF KIWIFRUIT**

ZESPRI™ GREEN (GREEN) Kiwifruit are described by consumers as having fresh, sweet-acid flavours, while the flavour of ZESPRI™ GOLD (GOLD) fruit is described as sweet, slightly tropical and fruity (Marsh et al. 2006). These descriptions sum up extremely complex interactions between many components such as soluble sugars, acids and volatile compounds that are rapidly released from the cells when we bite into the fruit. It is the volatile compounds that give the characteristic GREEN or GOLD flavour to the fruit, but consumers can also taste relatively small changes in levels of key components like sugars and acids. It is not just the total amount of each compound that influences our liking for a fruit, but also the balance between components. For example, kiwifruit with high DM have both higher sugar and higher acid levels than those with low DM (Woodward and Clearwater 2007), but consumers consistently prefer high DM fruit as they have more flavour (Harker 2004).

We have studied the interaction between sugars, acids and other flavour compounds using a kiwifruit pulp system (Figure 2). Addition of any of the main sugars increased consumers’ perception of sweetness of both GREEN and GOLD kiwifruit equally (Marsh et al. 2006). Sometimes increasing sugar levels also reduced perceptions of acidity in fruit. Adding small amounts of acid to GREEN fruit pulps always reduced consumer’s perception of sweetness and increased those of acidity. In GOLD fruit pulps, adding quinic acid to raise TA levels by about 0.3 per cent, had a slightly greater impact on fruit taste than similar additions of citric and malic acid. The same study also showed that increasing sugar or acid levels in fruit pulps altered both the measured amount of aroma volatiles and consumers’ perceptions of banana and lemon-like flavours.

**ACID CONTENT OF ACTINIDIA SPECIES IN THE KIWIFRUIT GERMPLASM COLLECTION**

We have also studied fruit from a range of Actinidia selections in the HortResearch germplasm collection, looking for fruit with unusual acid combinations that may contribute to unique flavours in future kiwifruit cultivars. Ripe fruit from most of the species tested contained some citric, malic and quinic acid; however, the amount and proportions of these acids varied (Figure 3). Fruit from species ‘four’ selections had the highest total concentration of acid, but the proportions of each acid were similar to those in GREEN and GOLD.
fruit. While the total amounts of acid in species ‘one’ fruit were similar to those in GREEN and GOLD, quinic acid made up 80 per cent of the total acid, with some malic acid but very little citric acid. Low acid levels were found in both species ‘two’ and species ‘three’ fruit. Both species had very little quinic acid, and species ‘two’ also had low citric acid levels. These differences in acid levels would contribute to very different flavour profiles. This suggests that there is potential to use between-species variation in acidity to influence novel flavours for new commercial cultivars.

**SEASONAL CHANGES IN ACID LEVELS IN GREEN AND GOLD FRUIT**

We measured the individual acid composition of both GREEN and GOLD fruit over a season from flowering, through fruit development until commercial harvest. The total concentration of acid in GREEN fruit increased rapidly during the first 60-80 days after flowering, coinciding with the rapid growth of fruit (Figure 4A). Total acids were also high during the early development of GOLD fruit. Thereafter levels declined slightly, reaching constant levels during fruit maturation.

Quinic acid is the main acid present during the early development of both GREEN and GOLD fruit and is mostly produced in the 60 days after flowering (Figure 4C). In contrast, citric acid (Figure 4B) only accumulates in fruit during fruit expansion, with concentrations staying stable or increasing slightly prior to fruit maturation and harvest. This suggests that quinic acid and citric acid production are not linked, but controlled separately (Cheng et al. 2004). In both GREEN and GOLD fruit, levels of malic acid vary widely before finally increasing prior to harvest (Figure 4D).

**EFFECTS OF CLIMATE AND MANAGEMENT ON FRUIT ACIDS**

Climate and management techniques are likely to affect fruit acidity and taste, but there have been few concerted efforts to record the effects of climate or preharvest treatment on kiwifruit acidity. Recent studies have shown that acidity levels in kiwifruit fruit are strongly correlated with fruit DM levels (Woodward and Clearwater 2007). Therefore we expect changes in both the environment and management that alter fruit DM content will also affect fruit acidity. For example, high temperatures during fruit expansion resulted in a major reduction in both fruit DM and total acid levels of GREEN fruit at harvest (Richardson et al. 2004). However in the same study, heating vines during fruit maturation reduced fruit DM, but did not affect fruit acidity. This suggests that in some cases DM and acid levels may respond differently to either management techniques or environmental factors. Therefore it may be important to measure acid levels during studies targeted at increasing DM.

The combination of both growing conditions and storage conditions can also affect fruit acidity and flavour. At harvest, acid levels of kiwifruit grown in warm conditions in California and Italy (Crisosto and Crisosto 2001; Tombesi et al. 1993) are around 2.5-3.5 per cent TA, compared with about 1.4 per cent TA in New Zealand fruit (MacRae et al.1989). However, acid levels in fruit grown in warmer climates can drop by 50 per cent during storage at 0°C, while there is little change in the acidity of New Zealand fruit during storage. In Italy, Tombesi et al. (1993) found that GREEN fruit which was artificially shaded had higher acidity levels at harvest than fruit grown in standard conditions, but the difference was lost in storage. In New Zealand, studies have shown that malic acid levels in fruit can increase and soluble solids levels decrease when fruit are stored at 4°C, but not at 0° or 10°C (Marsh et al. 2004). Malic acid levels can also vary in fruit stored in different CA environments (Harman and McDonald 1989). Therefore, effects on fruit acid levels may explain some of the differences in flavour between fruit grown in different countries or stored under different conditions.

**SUMMARY**

The flavour of fruit has a large impact on consumer acceptance. Kiwifruit flavour is largely determined by both the amount and balance between sugars, acids and volatile compounds. The specific combination of these components is influenced by factors such as genotype, environmental conditions, and preharvest and postharvest treatments. Understanding the dynamic changes in fruit acidity and taste during development and storage can help in optimizing these factors to enhance fruit quality and consumer preference.
aroma compounds. Dry Matter is a good indicator of a fruit's taste potential. Both sugars and acids levels increase with increasing fruit DM, however it is the balance between the two and the type of acids present (quinic, citric and malic) that gives consumers their overall impression of fruit taste. Widely varying total acid levels and the proportion of different acids present in Actinidia germplasm give some potential to create novel flavours through varying acid:sugar ratios in new cultivars.

Environmental and fruit storage conditions as well as management techniques can all affect fruit flavour, either by changing both DM and acidity, or by more specific effects on acidity alone.

ACKNOWLEDGEMENT

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REFERENCES


Tomorrow’s Kiwifruit Industry and Orchard Business Strategies

By Tim Woodward, ZESPRI Innovation and Rosstan Mazey, ZESPRI Marketing.

As orchardists strive to improve profitability they need to consider what the trends in the international kiwifruit industry are and where to focus their orchard businesses in the future to maximise orchard profitability.

In this article we look at what issues our industry may face in the future, and what will be required to supply our markets with the fruit products they desire.

In planning for the future, we need to be able to respond to an ever-changing economic environment, changing market demands and increasing competition from other kiwifruit producers.

**INCREASING COMPETITION**

World kiwifruit production has been increasing and is forecast to grow further. The returns of kiwifruit relative to alternative fruit crops have encouraged existing producers to expand their plantings and productivity, have prompted growers of other fruit to switch to kiwifruit and have encouraged new countries to enter into kiwifruit production. This expansion has significant implications for us all. In an increasingly competitive market ZESPRI must maintain and build competitive advantage through fruit quality and intangible attributes such as environmental and ethical considerations that underpin our brand and its ability to command premium prices.

**MONEY MARKETS**

Orchardists who attended the recent ZESPRI Focus Orchard Network Field Days heard how the international money market is changing. Speakers forecast the $ NZ to remain high against the Euro and Yen into 2008. Credit is becoming less available as money moves out of ‘riskier’ second tier financial organisations into the more conservative, ‘safer’ institutions. The consequence of this is that less money will be available for lending, and the credit, which is still available, will be much more

![Figure 1: ZESPRI™ Kiwifruit selling for a much higher price than competing fruit types in a specialist retail outlet in Spain.](image)

<table>
<thead>
<tr>
<th>Season</th>
<th>Italy</th>
<th>Chile</th>
<th>New Zealand</th>
</tr>
</thead>
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<td>$ 0.85</td>
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<td>$ 1.22</td>
<td>$ 0.88</td>
<td>$ 2.14</td>
</tr>
<tr>
<td>2003 - 04</td>
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</tbody>
</table>

|            | $ 1.07 | $ 0.77 | $ 2.06  |

Table 1: Comparative market returns between the big three kiwifruit producers 2000-2006 (US$/Kg). The prices shown represent the average prices received FOB shipping point. Source: World Kiwifruit Review 2007. Belrose Inc. (Note that there are significant differences in costs - refer to Table 2 overleaf).
risk averse. As one commentator has said “The availability of cheap credit is over”.

WE ARE DEPENDENT ON EXPORTING

The economic sustainability of the New Zealand kiwifruit industry is dependent on ZESPRI’s ability to profitably sell fruit in the international markets. Historically we have been able to sell our fruit in the export markets for a significant premium over our competitors (Figure 1 and Table 1). However, we are a high cost producer and supplier into offshore markets, (Table 2), and we need to achieve this premium to provide for the economic viability of the New Zealand kiwifruit industry. Our ability to get a consumer to pay a premium for our fruit is underpinned by our product meeting all their expectations and our ability to attract sales through high impact promotional activity. What a consumer wants from their fruit is changing, and our supply chain must evolve to meet these needs or our ability to command premium pricing may be compromised. A number of trends in our export markets have required us to adjust our understanding of orchard productivity from a simple view of gross fruit volumes produced to now considering the specifications of fruit produced to meet a number of increasingly discerning market requirements.

INCREASING MARKET COMPLEXITY

Supporting our industry’s need for premium positioning through quality is a comprehensive payments and supply chain system, set to incentivise then deliver on our exacting standards. The ZESPRI System, our world leading supply chain, has enabled us to successfully evolve and deliver to our changing consumer, customer and market demands. As a result the industry has become more flexible and we have been able to position ourselves as the world leader in kiwifruit, focused on delivering to the highest standards. The ZESPRI System is fundamental in providing support for our ZESPRI Brand and enables us to continue selling our fruit at a premium price in all of our markets.

High yield for lowest cost was previously the key focus for orchardists. However, our markets have begun to impose a number of requirements on their suppliers in terms of fruit size, fruit taste, food safety, production standards, and environmental concerns. Food has also become a symbolic battleground for many of the big social issues of today. Through their food choices, more and more consumers can cast their vote on ethical issues such as genetically modified food, sustainable or other eco-friendly farming practices, treatment of farm workers, carbon footprints and other similar social or environmental issues. With increasing affluence consumers are beginning to take a closer look at the systems which are involved in the production of the food they choose to buy.

We need to understand the evolving consumer motivations and the customer demands in order for us to continually develop and position our brand and ultimately sell our kiwifruit for a premium in our markets.

In summary, the international kiwifruit industry of the future will see:

<table>
<thead>
<tr>
<th>Producing country</th>
<th>On Orchard Costs</th>
<th>Postharvest Costs</th>
<th>Freight Promotion &amp; Other Marketing Costs</th>
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<tr>
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<td>$0.32</td>
<td>$0.31</td>
<td>$0.05</td>
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</table>

Table 2: Comparative costs in getting fruit to market between Hayward producing countries (US$/Kg). Source: IKO 2007.
An increase in the number of kiwifruit varieties that will be marketed to consumers in a range of formats (not just fresh fruit)

Industry consolidation and an increase in the number of major players

More challenging standards in both tangible issues such as the use of chemicals and in less tangible areas such as social equity

As we move forward the New Zealand kiwifruit industry, through the ZESPRI Brand and supported by the ZESPRI System, is well positioned for these potential changes.

WHAT SHOULD AN ORCHARDIST’S STRATEGY BE?

What do orchardists need to be thinking about to improve their profitability over time? From an individual orchardist’s perspective, the profitability of their operation is a function of the fruit price received multiplied by the yield produced, less production costs. 

\[
\text{Profitability} = (\text{Price} \times \text{Yield}) - \text{Cost}
\]

Real orchard yield is the number of trays of fruit sold in the export markets, and yield is the main determinant of orchard profitability. Real yield is a function of the volume of fruit produced that meets export grade standards, including phytosanitary, food safety and production standard requirements, and can be marketed. Orchard yield can be maximised by lifting production, minimising both fruit reject rates and fruit loss, and meeting market access requirements.

We need to be cost efficient, but remember that orchard income is dependent on producing a good quality crop that meets consumer, customer and market demands. In terms of cost cutting, it can be false economy to compromise on production costs. The example was given by Fred Jordan, one of the FON participants, who in past years of low returns cut back on thinning costs by doing it all himself, which resulted in some of the required thinning not being completed, compromising his yields. The reduced yields can cost much more than any savings made on reduced orchard operations.

All the FON participants have developed management strategies for improving orchard profitability revolving around increasing yields, and/or increasing premium payments received for the fruit before considering cost reduction. These FON growers are looking to...
optimise their current management spend and in some cases are looking to increase levels of investment to improve their yield.

As mentioned earlier the New Zealand dollar is forecast to remain high against the Euro and Yen into 2008. It needs to be acknowledged that the New Zealand industry is potentially facing returns over the next couple of years that will not be at the same level as they have been in the past. This environment has created a sense of urgency to review the entire cost structure of our industry. An Industry Advisory Council Working Group is currently undertaking analysis to identify sustainable cost reduction initiatives through the production, post-harvest, supply chain and marketing areas of our industry. It’s important that this process is managed collaboratively and that the long-term impacts of any changes are fully understood.

In developing a strategy for your orchard business to weather lower returns, consider the following advice that financial representatives offered at the FON Field Days:

- Plan ahead - don’t put your head in the sand.
- Complete orchard budgets so there are no financial surprises (model budgets are available at: www.nzkgi.org).
- Talk about your situation - seek advice from relevant parties e.g. banks, packhouse staff, consultants, ZESPRI Liaison Managers.
- Be open and honest with your bank manager and be talking with them now rather than only in a time of crisis.
- Look at reducing personal expenditure before/as well as orchard expenditure. Ask yourself the question “are my expenses sustainable?”

Helpful tips to save on financial costs include:

- Changing to interest only loans when cashflow is tight
- Make use of revolving credit facilities
- Consider splitting loans over different fixed-rate periods
- Consider bank fees as part of the loan costs and negotiate them with your bank manager

CONCLUSIONS

While the future will be challenging it is not all doom and gloom. Globally there is a world food shortage as arable land is coming under increasing pressure to go into biofuel production, and as a consequence food commodity prices are up. The New Zealand economy could grow on the back of the world food demand. Secondly, our kiwifruit quality and production system are better positioned than our competitors to meet the expectations of the increasingly affluent and discerning export markets.

All the FON participants have developed strategies for improving their orchard performance over the next three years. The orchard goals, the management strategies planned to achieve the goals, and the budgets for the FON participants are all available on the canopy website:

www.zespriancano.com (Innovation & Research > Focus Orchard Network > Field day handouts)

As profitability is expected to come under pressure in the future, then it is important that growers are aware of the key drivers of profitability in their business, and can therefore use this information to make informed decisions.

The FON programme will deliver to industry benchmarked growing costs and fruit revenues for a range of orchard management strategies. By following the progress of the focus orchards it is hoped that the wider grower community will have the confidence to adopt management practices that will add value to their own orchard operations.

FON = Focus Orchard Network.
Gold kiwifruit jellies - the perfect setting

Ross Atkinson, HortResearch - Mt Albert, Auckland

You can’t add fresh kiwifruit to a jelly and have it set – at least that’s what your grandmother used to say - and that’s certainly true for jellies made with the traditional ZESPRI™ GREEN kiwifruit. The reason the jellies won’t set is the presence of an enzyme in the fruit called actinidin. The actinidin enzyme breaks down the gelatine that holds the jelly together. Recently scientists at HortResearch (funded by the New Zealand Foundation for Research Science and Technology) showed that ZESPRI™ GOLD kiwifruit contain less than one per cent of the actinidin enzyme found in ZESPRI™ GREEN kiwifruit [1]. This means jellies made with fresh ZESPRI™ GOLD Kiwifruit set perfectly every time (Figure 1).

WANT TO TENDERIZE THAT STEAK?

The actinidin enzyme, abundant in ZESPRI™ GREEN kiwifruit, affects fruit processing characteristics and their healthful properties. Actinidin is responsible for the meat tenderizing properties of kiwifruit. The enzyme breaks down the links between proteins in muscle allowing the fibres to move apart. Actinidin is quite selective in the type of muscle fibre proteins it will attack. Although other enzymes (e.g. papain from papaya) can do the same job - they tend to over-tenderize the surface, producing a mushy texture [2].

LOVE IT OR HATE IT?

Actinidin has beneficial effects on human health. It is purified from kiwifruit to make digestive aids such as Zyactin™. The actinidin enzyme in these products helps to improve the breakdown of food protein into peptides and amino acids, promoting healthy digestive function. However, actinidin has also received some bad press, as it may potentially cause an allergic reaction in some sensitive people (http://www.zesprikiwi.com/allergies.htm).

WHEN AND WHERE IS ACTINIDIN FOUND IN FRUIT?

HortResearch scientists have found that actinidin levels increase throughout fruit development, peaking at harvest, then decrease as fruit ripen [1]. They have also looked to see where the actinidin enzyme was found in the four distinct zones of the fruit: core, flesh, area around the seeds, and peel. Actinidin was present in all four tissue zones in ZESPRI™ GREEN kiwifruit, with the highest levels in the flesh (Figure 2). In ZESPRI™ GOLD kiwifruit, actinidin was only found at low levels around the seeds. Interestingly, actinidin levels in many other gold fruit from Actinidia chinensis breeding populations are similar to those in ZESPRI™ GREEN fruit [1, 2].

WHAT’S IN IT FOR THE PLANT?

Why kiwifruit plants make so much actinidin is something of a mystery but high levels of similar enzymes are also found in other fruit e.g. papain in papaya and bromelain in pineapple. One possibility is that actinidin might act as a store of protein in the fruit. Both sugar and protein attract animals (and human consumers!) to the fruit, which helps the plant to disperse its seeds. Another possibility is that actinidin is involved in defence against insects or fungi. HortResearch scientists have recently...
shown that actinidin can inhibit the growth and survival of some insect pests e.g. caterpillars [3].

**SUMMER DESSERT FUN**

ZESPRI™ GOLD kiwifruit contains less than one per cent of the actinidin enzyme found in ZESPRI™ GREEN kiwifruit. Therefore the best advice at the moment - use ZESPRI™ GOLD to make that kiwifruit jelly for summer dessert fun (Figure 3). However, if you want to tenderise steak for summer barbecues, keep using ZESPRI™ GREEN.

REFERENCES:


This work was funded by the NZ Foundation for Research Science and Technology (CO6X0403), and HortResearch Internal Investment Funding (HII 06-04).
The continued high exchange rate has largely contributed to poor financial returns for all of us. In some cases high reject rates and/or fruit loss compounded by the poor returns has resulted in absolutely disastrous orchard gate returns this year. At NZKGI we know this because we are taking your phone calls asking for help. Without doubt this season has been the worst season we as an industry have experienced for many years.

But our financial problems are not all down to the high exchange rate. Over the last two seasons the cost of getting our fruit to our markets has dramatically increased. I am convinced that the only way to return the industry to financially viable orchard gate returns is to dramatically reduce our supply chain costs. A change in the exchange rate will be of great assistance but the long term viability of our industry depends on constantly removing costs from the supply chain. My view is that at least NZS100 million, roughly one dollar a tray, needs to be removed, and that we need to constantly focus on cost efficiencies. I hasten to add this cannot be at the cost of value and the factors that generate our premium return.

I’ll give you one example. If two fruit sizes, say 30’s and 33’s, were combined, the resulting savings are estimated to be around NZS10 million. This option is being investigated with the markets being asked how this will affect their ability to get top price.

WAR ON COSTS

In recognition of the need to get cost out of the supply chain the Industry Advisory Council at its October meeting declared a war on costs and set up a small group to identify cost savings. This group includes grower, postharvest and ZESPRI representatives and will identify initiatives for immediate cost savings. This is a good start. But to succeed it needs 100 per cent commitment from all of the industry.

I give you my and NZKGI’s total commitment that we will do all that we can to ensure that real cost savings are made and returned to you in your orchard gate return.

Although the cost to growers for running NZKGI is less than 0.008 of a cent, NZKGI itself is leading the way. Our financial year ends on 31 March 2008, but we are striving to return 12 per cent of our allocated funding back to the grower pool for this financial year. NZKGI’s Forum members have taken an immediate 18 per cent cut in their meeting fees. For the 2008 / 2009 financial year we are working to reduce our grower funding by 20 per cent on a permanent basis. We are doing this by re-considering the ways in which we work to find smarter and more cost effective ways of working without losing effectiveness. This is a tough but necessary challenge.

SINGLE POINT OF ENTRY

The foundation of the current industry structure is the industry’s single point of entry (SPE) - in short ZESPRI’s marketing monopoly. The SPE came about as a result of the failings of the multi-exporter model. Its creation was supported by the vast majority of growers and from what I’ve seen that support continues today.

The SPE provides essential advantages in a year like the current one when grower returns are under extreme pressure. It is not hard to imagine what returns would be like if competing marketers had all marketed the increased volume of fruit to the highest paying markets.

For the SPE to remain in place it must continue to serve all growers. The key measure from the growers’ point of view is growers’ return. Therefore the current situation is putting the SPE at risk. The Industry Advisory Council’s (IAC) war on costs is appropriate and timely. Removing costs is one way in which to increase growers’ return. The IAC’s war on costs needs to impact growers’ returns from the 2008 season onward. This is needed to maintain growers’ confidence in not only the future of their industry but of the SPE itself.

COST CUTTING PLEDGES

To meet this immediate need NZKGI has invited industry participants to pledge cost cutting that will directly benefit the growers’ returns.
NZKGI making its pledge in isolation will not have a marked effect unless other industry participants make similar pledges. One of the industry’s strengths is its cohesion and integration. Industry participants recognising growers’ financial predicament and responding as one will also serve to enhance the industry’s cohesion and integration. Kiwifruit New Zealand and Horticulture New Zealand have both received invitations to return to the growers 20 per cent of their pool/levy funding. NZKGI has also invited ZESPRI Group Limited to consider increasing the loyalty premium and/or paying a special dividend and/or cutting ZESPRI’s corporate operating expenses by a target of 20 per cent.

YOUR ORCHARD GATE RETURNS

What many growers are doing in these challenging times is to become more involved with on-orchard activities to immediately save costs as labour is the biggest expense. NZKGI have recognised a need to enable growers to further develop their skills in managing their orchard as a business.

Some advantages for growers include gaining a better understanding of what you are paying for activities on your orchard and when the expense is likely to occur. Developing financial skills will allow growers to negotiate better with lending institutions so growers will know how much and for how long they may need to borrow money. Managing your finances will also tell you how much money is available to be drawn out of your business or how much capital you have available to invest in your orchard.

Improving management skills will help growers get the best out of their workers and the results they expect. There is a tremendous amount of value in being closely involved with the orchard operations, having clear goals and measuring your results against these goals.

NZKGI have, in co-operation with service providers, arranged a number of courses to continue developing grower skills. These courses are:

Better Business Skills:
This is a repeat course and is being run again in Tauranga on 1, 8, 22 and 29 February 2008 from 9 am - 12 noon. This course challenges kiwifruit employers to improve their business management skills and teaches them how to manage and get the best out of their staff. We are negotiating to run this course also in the Eastern Bay pre-season.

Financial Management/Training Support for Kiwifruit Businesses:
Due to the success of the first course this course is being run again next year for those who were unable to attend. The time involved is two half days on 5 February and 13 February. This course is targeting orchard owners and managers and focuses on developing/advancing financial planning skills and giving attendees a tool kit to project and improve the financial stability of their business.

Both the Better Business Skills Course and the Financial Management/Training Support Course for Kiwifruit Businesses are free courses for those employers who have less than 50 full time permanent employees working for them.

BUSINESS COACHING

NZKGI have a range of business mentors available so if you would like to make use of this service please contact NZKGI’s Office.

BUDGETING AND CASHFLOW TOOL

Many growers do not have the tools to carry out budgeting or cashflow forecasting. To meet this need NZKGI have developed a budget/cashflow tool. This is a very important part of successfully managing your business. This spreadsheet allows growers to enter their income as well as their direct costs and capital costs. The grower will then be able to more effectively manage and understand their finances. The expenses and timing of the costs in the spreadsheet are based on industry averages. So if you find any of your expenses are in excess of these costs then you need to look very carefully at the benefit you are getting for the additional spend. The budget spreadsheet can be found on the NZKGI website under Grower Advice or you can contact the NZKGI Office for a copy.

Please contact the NZKGI office on 07 574 7139 or toll free 0800 232 505, if you would like to speak to somebody that has already attended the course, if you would like to register your interest in attending this course or if you need help.

I am sure that with full commitment and effort our industry will work through the current financial situation and that orchard gate returns will become viable again. We at NZKGI are totally committed to achieving this.
This article looks back at the weather of 2007 and then ahead at the summer of 2008.

The German based Munich Re-insurance group is researching the increase in damage around the world being done by natural hazards. They recently issued a news release on their web site at http://www.munichre.com/ stating that there has been a steady rise in weather-related natural catastrophes during recent decades. Taking inflation into account, economic losses in the past 10 years have more than doubled compared with the 1980’s. Weather-related natural hazard events are expected to increase in number and severity in future, due to the impacts of climate change.

All this is gloomy enough, but some nice colourful graphics may help to keep us cheerful. The time section graphics come from the Climate Diagnosis Centre on NOAA on their http://www.cdc.noaa.gov/ map/time_plot/ web site and I appreciate their help. These images help to give us a quick look at the full range of air temperature and its changes over New Zealand for the past year in a glance.

For each day the longitudes from 165 degrees east to 180 are averaged and a colour coded line is drawn to show the air temperature from 50 degrees South latitude on the far left to 35 degrees South on the far right. Time runs down the graph so that
December 2006 is at the top and November 2007 is at the bottom.

It was a cold start to summer. In fact December 2006 was the coldest in many places for the past 50 years. This was likely due to the effect of some melt-water flooding northwards from out of the southern ocean. We even had some icebergs off the South Island. Summer only brought near average temperature, but there were warm episodes in autumn, especially in May. Winter arrived with a bang in early June, but winter and spring seemed to have a chaotic mix of warm and cool periods. Things started to warm quickly in late November.

If you compare the temperature anomaly graph shown above with the one for 2005 published in the January 2006 New Zealand Kiwifruit Journal you'll see that, overall, 2007 was cooler than 2005.

The Hawke's Bay drought finally broke in June 2007. Rain amounts were between 15 per cent and 79 per cent of normal for nine out of ten months. Direct losses to livestock farmers through this period have been estimated to be around $300 million, and some have been calling it the drought of the century.

Looking at the Insurance Council of New Zealand's web site shows that the cost of insured weather damage payouts in New Zealand (at http://www.icnz.org.nz/current/wx.php) 2007 stands (to end of November) at $81 million, compared with $50 million for 2006. The main storm for 2007, as measured by insured loss payouts of $50.5 million, was the storm that affected Northland, Auckland and Coromandel on 10-12 July. This was given a special mention in the weather article in the September Kiwifruit Journal. The second worst storm was a similar event (payout of $12.5 million) affecting the Far North on 29 March. This was covered in the weather article in the May Kiwifruit Journal, introducing readers to the idea of a storm that worked like an eggbeater.

Here is a brief summary of the main weather events for the year ending November 2007.

During December 2006, anticyclones lingered over Victoria and Tasmania causing headaches for Australian fire-fighters, and seven low-pressure systems deepened near Chatham Islands. Between these features New Zealand has had more southerly winds than normal so that 16 (out of 87) climate stations had their lowest average temperature on record. The national December average of 13.7°C was lowest since the 13.4 °C of 2004, and equal with 1946.

On Monday 18th a convergence zone over the Bay of Plenty triggered an afternoon downpour around Rotorua where a girl was briefly swept along a flooded drain. On the 20th, Whitianga and Whakatane had downpours and a cold front brought a southerly change with surface flooding in Christchurch city and snow on the central Otago hills. On the 30th, Ashburton and Mt Somers had downpours and flooding. A camping ground near Geraldine was evacuated due to flooding.

January was dull. Nelson and Takaka had their lowest January sunshine on record.

On January 2nd, a cool southerly change brought a heavy ten-minute hailstorm to Te Puke.

On the 14th, a frontal system stalled over the Bay of Plenty area and brought some slips around Rotorua.

On the 22nd, a strong northwesterly flow brought the monthly high temperatures of 33.5°C in Napier and Hastings and a warm front caused flash-flooding which affecting trampers near Dusky Sound.

February was very dry in many areas, especially around Whangaparaoa, between Taupo and Rotorua, about the Nelson coast and over Westland and Otago. Ranfurly reported no rain at all, and Lake Tekapo only 0.4 mm.
The main rain event of the month was from the 5th to 7th when a tropical Low moved from Fiji to the Kermadecs and an accompanying rainband stalled over the Far North. Kaikohe had 172 mm in two days (27 mm/hr between 3am and 4am on the 7th). Flooding took out the bridge at Te Koa, isolating around 500 people including 60 tourists.

In March anticyclones lingering northeast of Chatham Islands fed a humid easterly flow onto northern districts.

On the evening of the 13th, lightning and squalls brought minor damage to Auckland and cut power for three hours to Kapiti. On the 14th, a low pressure system deepened to 980 hPa off Kaikoura bringing wind damage to Auckland, Kapiti and Wellington. Surface flooding affected Raumati beach and snow settled near Lake Rotoiti. On 17th and 18th, a series of fronts crossed the country: the Westport area had surface flooding from 40 mm of rain in two hours; rain triggered a collapse of the rim of the Crater Lake on Mount Ruapehu and a southerly change in Christchurch was accompanied by a severe hail storm. On the 21st, a tornado was reported near Stratford. On 28th and 29th, a very moist northeast airstream stalled over Northland and brought extreme amounts of rain: highest two-day totals were at East Whangarei (436 mm) and Puhupuhu hills (434 mm). The Kaeo River broke its banks, houses were washed away at Haruru Falls, the approaches to the Kerikeri store were flooded, and slips closed roads and cut off Opua. Total insurance payouts for this storm were $12.5 million.

April was generally dry and anticyclonic in New Zealand.

On the 11th, two trampers in Westland were caught by flooded rivers. On the 13th, snow briefly settled to 300 metres on the hills around Alexandra and Lumsden, gales affected Auckland and Southland and wind damaged some avocado trees in the Bay of Plenty.

Then came the warmest May on record both in Australia and New Zealand. It was also dry in several northern and eastern areas with Pureroa in the Bay of Islands, Whakatane, Gisborne, Napier, Kaikoura and Dunedin all reporting rainfall of less than 10mm. The month was dominated by northwesterly winds.

On the 2nd, a 50mm pre-dawn downpour brought surface flooding to Wellington, and winds damaged a building site in western Bay of Plenty. On the 11th, a small tornado lifted a few roofs in and around Greyouth. On the 15th westerly winds gusted to 59 knots in Invercargill lifting roofing iron, uprooting trees and disrupting power supplies. On the 23rd, a front brought torrential rain to the Nelson area and, a few hours later, to the Taranaki area. On the 27th, westerly winds gusted to 60 knots in Invercargill and 53 knots in Dunedin.

In June two polar outbreaks brought in an early winter.

The first arrived on the 6th to the 8th knocking over trees and power poles in the Kaweka ranges, bringing gusts to around 60 knots in Invercargill and at Dunedin Airport and 20 cm of snow to Clinton. In Southland, power-lines were toppled by combined effects of snow and wind. In Otago, fires from arcing power-lines were fanned by the wind. The second arrived on 21st to the 25th and its snow closed many roads and airports about inland.
Southland and Otago. Alexandra, Roxburgh and Queenstown were cut off. The start of the Queenstown winter festival was postponed. Reefton had up to eight cm of snow, its biggest fall since 1969. Powerlines toppled near Clinton, where one metre snowdrifts were reported. On the 24th snow affected Dunedin hills and winds gusted to 80 knots at Taiaroa Head. Abnormal eight metre swells eroded the shoreline between Dunedin and Oamaru. On the 25th, snow dusted the Desert and Rimutaka roads.

July brought the most damaging weather of the year with cold wet and windy conditions. On the 4th, a tornado hit New Plymouth’s business district. The next day multiple tornados affected Taranaki bringing property damage estimated at $7 million. On 7th to 9th July, polar chilled air arrived over central Otago and inland Canterbury producing seven million dollars of frost damage. Subzero air settled in central Otago for the following fortnight. On the 10th, a state of emergency was declared in the Far North when a passing depression was accompanied by heavy rain and an easterly gale. Many houses were evacuated in Kaeo where 254 mm of rain fell in 12 hours. The
combination of wind and rain brought serious disruption to Northland, Auckland and Coromandel. Whangarei was cut off for several hours. Regional power cuts affected more than 140,000 people. Estimated damage was $60 million. On the 17th, a low-pressure system crossing the North Island brought flooding that caused two schools to be evacuated. On 30th and 31st, a third low brought flooding to Otago and caused evacuations in Morven, Milton, and Palmerston and a state of emergency was declared when the Taieri River overflowed.

August was relatively quiet. On the 10th and 11th, vigorous northwesterlies brought power cuts to central Otago, then the southerlies that followed brought snow to Mt Somers and the Catlins.

Early September brought another cold outbreak. On the 4th, snow closed schools in the Canterbury Plains, disrupted traffic in Dunedin and brought minor stock losses, but helped top up the Otago and Canterbury ski fields. On the 19th, heavy rain fell in Northland and floods temporarily trapped a group in the Waipa caves.

October was marked by prolonged periods of strong westerly winds.

On the 6th, there were power cuts in Hawke’s Bay, Wairarapa, Wellington, Kaikoura Coast, Banks Peninsula and Oxford. On the 14th to 16th, trees were blown down on the Takapau plains and a motorbike was blown off the road near Woodville. The most notable event in these equinoctial gales was on the 23rd, with widespread wind damage and power cuts over Southland. Roofs were lifted in Dannevirke and Highway 50 in Hawke’s Bay was closed after two trucks were blown over. On the 24th, a freak wind gust in Christchurch fatally swept a schoolgirl into the path of a bus.

In November some lazy anticyclones produced extended dry periods over eastern and central districts, with the most notable dry period lasting from 17th to 23rd. On the 20th, a fluke gust of wind tipped a light-winged plane over as it was trying to takeoff from Wellington Airport.

**WHAT’S HAPPENING NOW?**

Moderate La Nina conditions are present across the tropical Pacific, as shown by a zone of cooler than normal sea located along the equatorial from west of the date line to offshore of Peru. This cool zone continues to intensify and to expand to the west, but a few hot spots are weakening it near the Peru Coast. Measurements show that sub-surface sea temperatures are also cooler than normal, and computer models predict that this La Nina episode will last until at least early 2008. The probability of such an occurrence is judged to be 90 per cent.

Surrounding this cool pool is a horseshoe of warmer-than-normal sea, and the southern branch of this is especially noticeable around Fiji, along with some rapid warming of the sea recently around Tasmania and the southern parts of the South Island probably related to the recent anticyclones. This extra warmth may well enhance showery conditions here late in summer, but not in the next few months.

The Southern oscillation index has risen during November and its 30-day running mean is now over the 1.0 threshold for a La Nina event. The 90-day running mean is at 0.7 and rising. This indicates that the atmospheric weather patterns are catching up with the oceanic patterns and that standard La Nina-like weather is very likely during the coming summer. The last time we had a similar La Nina summer was in 1999/2000, and if you can recall the drizzly grey dawn on 1 Jan 2000, then that’s a typical La Nina summer weather pattern.

**WHAT’S LIKELY FOR SUMMER**

Typical weather patterns in a La Nina summer are larger than normal anticyclones taking a path across Tasmania and the South Tasman Sea. Some of these will then cross central New Zealand bringing periods of sunny warm dry weather, and others slip around the seas south of New Zealand. These high-pressure systems then re-intensify east of New Zealand and bring periods of humid northerly or easterly wind sometimes with rain affecting mainly northern and northeastern districts.

Between these anticyclones the intervening troughs of low pressure with fronts and low pressure centres are likely to mainly roll in from the Tasman Sea. Some of these troughs may be preceded by a northwesterly flow stretching back to Australia bringing heavy rain to the Southern Alps and hot, dry, and gusty conditions to eastern areas from central Otago to Hawke’s Bay. Some may well be followed by a few days of cooler south or southeasterly flows which may bring welcome rain to eastern districts. If you can remember the weather we had on 1 January 2000, that was a perfect example of this La Nina summer pattern.

In a La Nina summer, we are open to whatever weather systems the tropics to the north and northwest may send in our direction. NIWA studies show that in past La Nina episodes the chances of being hit by a tropical cyclone remain near normal for New Zealand. So there is an 80 per cent probability that at least one cyclone from the tropics will affect parts of New Zealand this summer.

All in all, so long as the extreme events stay away from your part of the world, the seasonal outlook is looking sunny and damp enough for kiwifruit growing in Northland and the Bay of Plenty, but on the dry side for Nelson and Manawatu growers. Hawke’s Bay was very dry during late autumn but a La Nina summer should bring average rainfall. ■
The Taste ZESPRI™ programme was introduced to encourage New Zealand kiwifruit growers to produce kiwifruit of higher dry matter at harvest. This harvest dry matter is considered to be the best predictor of the final eating quality of the fruit when ripe. The aim of the programme is to deliver a better taste experience for the consumers of New Zealand kiwifruit. ZESPRI Innovation have been concerned that there are a large proportion of growers who are not using the tools that are available to them to lift fruit dry matter. In order to identify some of the barriers to adoption of these tools ZESPRI contracted Fruition Horticulture to run a series of focus groups with kiwifruit growers. This article summarises this series of six focus groups run in September. Panelists from three of the groups were randomly selected from a list of “innovative” orchardists and the makeup of the other three were selected from “conservative” orchardists. Orchard Gate Return (OGR) per hectare (as derived from ZESPRI databases) was used as a proxy for this. That is, orchardists with a higher OGR were deemed to be more innovative than lower OGR orchardists for the purpose of this study.

In general the focus groups were supportive of the Taste ZESPRI™ programme with the exception of one group where strong views were expressed about the equity of taking money from a group of growers to reward another group of growers. Some questions still remain amongst growers regarding the relationship between fruit dry matter and the in-market eating quality of the fruit and also the testing methodology used to establish the harvest dry matter levels and hence the premiums paid to growers. Growers also expressed a degree of confusion about the premiums paid and the language and acronyms used to describe these premiums.

When asked about the perceived effectiveness of tools to lift fruit dry matter there was a clear difference between the two broad groups of growers. The focus groups consisting largely of growers generating a high OGR discussed producing high dry matter fruit in terms of plant physiology; focusing on how you convert the sun’s energy into carbohydrate and how this carbohydrate is partitioned within the plant. The focus groups consisting largely of growers who generated a low OGR expressed exasperation and confusion. One quote from the group summed up the feelings: “You don’t know what lever you’re pulling to change dry matter.”

Growers generally agreed that the only technique that was recognised to consistently lift fruit dry matter was trunk girdling. Many growers, however, expressed concerns about the long-term sustainability of trunk girdling and also concerns around the impacts of trunk girdling on the storage life of fruit and fruit quality parameters in the following season.

The other tool that growers viewed as significant in lifting fruit dry matter was canopy management. The discussion did highlight the degree of confusion that exists about the terminology used to describe canopy management strategies and how to achieve the desired canopy. This issue was recently identified in a HortResearch report on high performing kiwifruit growers, a report that recommended more be done to educate growers, managers and contractors on how to achieve the ‘low vigour canopy’ linked to the production of high dry matter fruit.

When discussing the barriers to adoption of the technologies to lift fruit dry matter there was a significant range of expressions used to describe trunk girdling. Many growers used quite emotive language such as “it’s like wringing the vine’s neck” or “it’s unnatural”. Others suggested that the practice of trunk girdling was contrary to EUREPGAP (recently rebranded GLOBAL GAP) in that it was an ‘unsustainable’ practice. On the other end of the spectrum one grower suggested that growers should rethink the terminology that is used and simply consider trunk girdling as “applying a controlled cut”.

The other significant barrier to the adoption of other technologies purported to lift fruit dry matter was the lack of sound scientific research including a cost benefit analysis to convince growers that a technique not only works but also that it is economically beneficial.

Growers expressed positive opinions about the technology transfer strategies used by ZESPRI to get growers to lift their fruit dry
matters. The various methods that growers stated they preferred for the delivery of technology transfer reflects the variety of learning styles that are witnessed in the wider population, that is, a mix of those who learn visually, by listening or by doing (kinaesthetic learners). Technology transfer strategies need to consider these various learning styles. The recently launched Focus Orchard Network is likely to fit all these learning styles and the need for economic analysis well. Growers also expressed a range of preferred delivery means from electronic means to individually addressed letters to hands-on demonstrations. This reflects not only the growers’ individual learning style of growers but also their comfort with technology.

Many of the growers in the focus groups producing the low OGR appear to be typical of the growers a recent Colmar Brunton research document described as averse to change and driven by lifestyle rather than returns. They are least likely to have contact with ZESPRI and the communication that they do want they would prefer to be delivered by post, not electronically. Given these growers account for around a quarter of the grower population, a programme directed specifically at these people to lift fruit dry matter may be required. The other groups are either very content with the systems as they exist or will respond rapidly to any financial incentive that is placed in front of them.

In view of the results of this series of focus groups a number of recommendations were made. These are discussed below.

CONTINUED RESEARCH INTO TRUNK GIRDLING.

Many growers wanted to see those vines that were originally trunk girdled to be continually girdled so that any long term detrimental affects on these vines can be monitored to act as an ‘early warning system’ for growers.

Growers were also interested in understanding more fully the impacts of trunk girdling on fruit storage and fruit shape and size in the following year. Growers want to be confident that they can use trunk girdling without increasing the risk of spreading disease, for example Amillaria, in the orchard.

RESEARCH TO INCLUDE COST: BENEFIT ANALYSIS

Growers in the focus groups were keen to know that tools purporting to lift fruit dry matter not only worked but gave an economic benefit by use of the tool. They therefore would like any scientific trials reported to also include an economic analysis on the use of the tool.

LIFTING UNDERSTANDING ON HOW TO ACHIEVE A ‘LOW VIGOUR CANOPY’

These focus groups and the research undertaken by HortResearch, which interviewed a number of high dry matter kiwifruit producers, identified a gap in the understanding of some growers, managers and contractors on how to achieve the type of low vigour canopy associated with producing high dry matter fruit. Considerable effort is required to lift the level of education of all those involved in the decision making and those underneath the vines to ensure the right things are being done, at the right time and to the right standard.

Furthermore, there was considerable confusion expressed within the focus groups about what was the ideal canopy to run. This confusion was typified by one very experienced kiwifruit grower who commented that they had left everything one year and the next year they had pruned everything off – neither strategy made any difference to dry matter. This grower didn’t consider that while canopy management is important, the ‘no summer pruning’ and the ‘really heavy summer pruning’ are two extremes and neither extreme is likely to achieve the desired result and that seasonal pruning requirements and responses differ.

TARGETED TECHNOLOGY TRANSFER PROGRAMMES

It is clear that ‘not one size fits all’. Growers, just like the rest of the population, differ in the preferences they have for accessing information. Improved understanding of the learning styles within our industry would be beneficial. It is important that any technology transfer programme considers the range of learning styles represented within the kiwifruit industry and provides a bias toward those who prefer to learn by doing, the kinaesthetic learner. It is my observation that those involved in horticulture are most likely to prefer this learning style. Furthermore, the Colmar Brunton study identified some clear groupings of growers for whom lifestyle rather than returns are a clear motivator. A strategy targeted at these growers is required as these growers are identified as having the least contact with ZESPRI and are possibly going to be the most difficult to shift in terms of changing orchard management to lift fruit dry matter.

LINK BETWEEN HARVEST DRY MATTER AND IN-MARKET TASTE

Further effort is required to convince growers of the link between fruit dry matter at harvest and in-market taste. Many of the growers participating in the focus groups...
were either completely unconvinced that there was a link or that dry matter was not the "complete story". Despite the research that has been conducted supporting the link between dry matter and taste, the message has still not hit home to a majority of growers in the focus groups.

TESTING METHODOLOGY

Growers in the focus groups expressed concern about the variability in test results they have received or heard of, impacting significantly on the payment of premiums to growers. While statisticians have reviewed the testing regime and declared that test methodology predicts dry matter as well as could be expected and that there are no compelling reasons to change it, growers remain unconvinced of this. Further effort is required to enable growers to understand the inherent variability in kiwifruit and the significant cost involved in instituting a more rigorous testing regime.

ZESPRI AND SUPPLIER COMMUNICATIONS

Considerable confusion was expressed by growers about the premium payment system and the financial information conveyed by ZESPRI. The entire premiums payment system needs to be simplified in order for growers to understand it. Furthermore, suppliers need to be clearer on their policy with respect to premiums that are not intended to go in-full to the grower. For example, Supplier Taste Payments. One grower commented that they thought they were going to receive the full 75 cents per tray for fruit achieving a certain criteria when in the end they only received 45 cents per tray. They considered this as a direct loss to them and they therefore are not prepared to work toward achieving this Supplier Taste Premium again.

Considerable discussion was also had within groups about the language used to describe financial information and all of the acronyms used. A strong view was expressed that ZESPRI should review their communication with growers to reduce the use of acronyms and make financial information, for example the back page of the Kiwifiler, more easily understood.

These focus groups, it is hoped, have identified some issues that are of concern to growers reading this article. In terms of technology transfer, the discussion within the focus groups, indicates that ZESPRI’s recently-launched Focus Orchard Network is on the right path in terms of delivering to a range of grower-preferred learning styles and also the need to see the economic analysis behind any tools available to lift fruit dry matter. The groups were also relatively supportive of the Taste ZESPRI™ programme and the technology strategies currently used by ZESPRI Innovation. The challenge for ZESPRI rests with convincing a reasonable majority of growers of the link between harvest dry matter and in-market taste and also assuring growers that the testing methodology is the best system currently available. It was clear from these groups that there are also issues around communication from ZESPRI and suppliers regarding financial information. Finally, growers need to be confident that tools such as trunk girdling are not going to be detrimental in the long term to what is producing their incomes and forms the basis of their asset value, their kiwifruit vines. ■

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Post this coupon to: Kiwifruit Journal Subscriptions PO Box 13039, Tauranga, New Zealand
I am back after a break away from my writing duties. Early last year we purchased a small block of ZESPRI™ GOLD Kiwifruit and we have set about tending the crop, for the 2008 season. This should be easy. We are going through a learning curve of what to do and what not to do to maximise your return from a grower’s perspective. It all appears easy, until the leaves won’t drop off after picking and you have to wait to get the pruning done. So much pruning. So little time!

What next? Tie them down?

Get the soil tested, apply some fertilizer, but what kind? It’s like fishing. Anyone can tell you how to catch fish, but they can’t show you the big ones they caught. Check the frost protection and pray a couple of times, one for a couple of frosts, then another for not too many, that’s because the buds are on. Its all about timing. Spray this and that. Are you sure that the frost protection is working? Test it again. The flowers are opening. I need some bees. Is it going to rain? Do I need artificial pollination? Bees work (maybe)!! We will see. Now things are growing! Maybe I put on too much fertilizer? I wonder what the place would look like if left unattended for say, two years? Better get pruning. Too many fruit. Take some off. That seems weird. Wow! doesn’t time fly when you are having fun. Mother Nature waits for no one.

It’s all about preparation.

The crop is now well underway. We should now prepare for the harvest. Pre-season maintenance is preventative maintenance. The more you can do now pre-season, the less downtime you will incur. Downtime and stoppages are unrecoverable losses.

So run the machinery, start all aspects of your plant and test it. Have repairs undertaken and be prepared.

**HANDLING GOLD KIWIFRUIT**

Over the last 15 years, postharvest machinery has been evolving to handle ZESPRI™ GOLD Kiwifruit in a gentle manner.

It is more easily damaged because of the softer skin type and the protruding hard calyx that grows on the end of the fruit. This calyx appears to cause the most damage through scuffing and physical punctures. The way we handle this product has become more and more critical.

Fruit damage is a direct loss to the grower and the penalties placed for excessive reject rates because of physical damage, seem a little unfair. This is when the grower believes the fruit has been grown with all care. All growers realize this fruit will damage easily and can accept a certain amount of handling damage, because that’s the nature of the beast.

We have to continue to find ways to reduce this damage for the grower. In my opinion, the operation from picking, processing, through to the export tray requires a continuing review.

I know and understand that this happens already as I have attended many meetings to discuss ways to eliminate damage in all areas. I hear anecdotal evidence being used continually, and have found with frustration no direct correlation to quantify where this damage is occurring and at what percentage.

Yes, we know it is damaged when picked. Yes, we know it is damaged when transported. Yes, we know it is damaged when it is processed and packed.

Is it not about time we collectively set in place some guidelines to reduce this loss and gained some conclusive evidence as to the best practice?

**EXAMPLES AND SUGGESTIONS**

Picking - do not drop the fruit. Place all fruit by hand from vine to bag. Do not waterfall fruit under any circumstance! Quality control bins at orchard and trace bins from orchard to packhouse. Quality control bins prior to tipping access and pay bin rates according to the percentage of damage and pay a premium for a reduced damage percentage.

Transport from vine to headland with suitably sprung trailers to reduce compression damage. Transport using trucks with soft suspension, air bags or similar. (This happens already)

**POSTHARVEST**

Use tipping and bin handling systems that do not drop or squeeze fruit but place the product onto a conveyor system with care and control. Ensure the transfers throughout the plant have a transfer height of say 100mm or less and that they don’t allow fruit to fall or bounce but to travel in mass and stay together avoiding collision impacts. Set a brushing standard in relation to how much brushing is required.

All damaged fruit should have been removed prior to packing.

**QUESTION**

Do speed, velocity, collision impacts and gravity drops create another issue after the grading tables? I leave this all open for discussion. I hope this opens a pathway to the answers we are all desperately looking for.

Paul Ross
Fruit Sorting Systems Ltd.

PS. Anecdote. Meaning = (n) a short amusing account of an incident. We need more than Anecdotal evidence, we need Conclusive.
Orchard productivity remains a key driver in orchard profitability. Orchard owners on aging T-bar orchards are severely limited in their ability to achieve rewarding yields. Long-time orchardist Dick Sayer says while it made good economic sense to convert his T bar orchard to pergola, he was reluctant to outlay the capital while margins are so tight.

"I'd often done the figures, and it all made sense to upgrade my orchard. The problem is while margins are low, as a grower you’re very reluctant to spend so much money on your orchard," says Dick.

"I discussed the problem with Seeka’s rep Al Riley, and he suggested Seeka might be able to initially fund the conversion. As a grower, that almost sounded to good to be true."

Seeka undertook a feasibility study looking at the cost versus the benefits of converting the orchard to pergola. They obtained two quotes for the work, with Dick also obtaining an independent quote.

"Seeka’s work confirmed my calculations that the improved productivity would pay for itself. They then offered to assist funding the conversion using a deferred payment facility in return for a term supply commitment.

"We made the decision to proceed with the conversion, and adjusted our summer prune to ensure there would be enough wood to span the pergolas once the conversion was complete. As an early KiwiStart orchard we had the fruit off by 31 March, and the conversion was well underway by mid April, with work finished before the winter rains set in.

"Canopy coverage is excellent. I’m now able to do a bud count and I’m expecting a significant lift in yields this season."

Traditionally Dick’s orchard achieved about 7000 trays a hectare with good KiwiStart payments contributing to consistently high orchard gate returns. After the conversion, Dick is forecasting yields should grow about 20 percent to 8500 trays per hectare, which will make a significant contribution to the bottom line.

"A higher yield is only one of the benefits," says Dick.

The old structures were tired and starting to break down. The other problem was getting labour, particularly pickers to work on T-bars. During the conversion we also managed to selectively remove shelter belts. The orchard is currently being re mapped and I expect canopy hectares which used to stand at 5.6 hectares to almost reach six hectares.

"The improved yields will more than cover the repayments. The total cost was $135,000 and with Seeka’s assistance I am able spread payment over a five year term.

"With the current high interest rates, this facility represents a considerable investment by Seeka in my orchard. It comes at no cost, only the obligation to supply Seeka Growers Limited for a set number of years," he says.

Seeka’s client relationship manager Al Riley says it’s a win-win situation for the grower and Seeka.

"Dick gets a significant lift in his yields, which as a Kiwistart grower will mean a considerable lift in orchard profitability. Higher yields also benefits Seeka because we will be able to pack more fruit. It also strengthens that essential relationship between grower and packhouse. As a packer we realise that helping our growers earn more makes good business sense," says Al.