Maximizing profitability when going Organic

Maintaining yield and quality in certified organic apple orchards

A report for

by Jason Jarvis

2008 Nuffield Scholar

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Foreword

Certified organic apples in Australia currently attract a premium over conventionally produced product. Some conventional producers are being enticed by the lucrative returns and requests for organic produce are coming from their existing market channels. Organic production has seen constant growth over recent years to meet increasing demand, though it is expected that the current global financial downturn will slow this growth and reduce premiums to some extent. The three year conversion phase where fruit is produced to organic standards but cannot be marketed as organic is seen by many producers as a risky proposition.

As apple producers working towards organic certification our first concern was maintaining profitability. Profitability during the conversion phase comes down to three things. Yield, cost of production and price received. During the first conversion year, fruit must be grown organically but not marketed as organic. In the second and third conversion years fruit may be marketed as organic in transition if a market exists for this. Price received in the apple market is influenced by many factors including supply/demand, variety, level of value adding / specialized marketing. Quality issues like size, colour percentage, defect levels (pest and disease pressure), storage-ability, which affect packout percentages are most within producers' control.

Our decision to undergo the organic certification process came after eliminating most chemical inputs we had previously used as conventional producers and instead focusing on improving the health of our soils and trees using a biological approach. Gaining organic certification will enable us to take advantage of an established market category and potentially realize some extra returns for our efforts.

Common belief is that if you convert to organic, yield will reduce, cost of production will increase and quality will reduce. My research focused on understanding whether these beliefs were justified, and if not, what were the key factors which allowed producers to avoid the pitfalls.

My research involved visiting several growing regions around the world to better understand what growers were achieving both in their production and marketing and to see if any production techniques could also apply in our situation.

My travels included visiting China, Japan, USA, Holland, Italy, UK and New Zealand. Prior to leaving Australia I completed a one week Certificate in Sustainable Agriculture course run by Graeme Sait of Nutritech Solutions in Queensland.

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To the many producers, consultants, researchers and suppliers who took time out of their busy schedules to accommodate my enquiries, I extend a sincere thankyou. A special thankyou to those who hosted me, helped to arrange meetings and suggested contacts.

To the great group of fellow Nuffield Scholars I had the pleasure of travelling with and learning from on our global focus tour.

Most importantly to my wife Fiona and children Davin and Kasey for their love and understanding, and my parents Henry and Joy for their support and resilience and coping in my absence with the business during a stressful year.

My Nuffield experience has provided amazing opportunities to broaden my horizons and to reaffirm my passion for biological organic farming. I am confident that my continued association with the global Nuffield network will pay dividends for many years to come.

Dedication

I wish to dedicate this report to the memory of my father Henry Edward Jarvis who died suddenly on the 29th of April 2009. Dad was a passionate farmer and dedicated family man. He was a well respected, long serving member of the fruit growing industry and held various positions at local, state and national levels over the years. Last year this commitment was acknowledged when he was awarded Life Member of the Western Australian Fruit Growers Association. Dad was a self made man who took pride in his work and worked hard for what he accomplished. His open minded, common sense approach to farming and life in general allowed him to embraced new ideas. Dad belonged to the land and enjoyed the challenge of farming for the future. As a father, a mentor, a partner and a friend, I am eternally grateful for the guidance, love and support he gave me.

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Executive Summary

Growing apples organically is still an engineered process. It demands that producers draw on all the management skills required by the best conventional growers and more, but without the 'safety net of toxic rescue chemistry' to fall back on.

This report focuses on some of the ways that producers around the world are maximizing profitability through maintaining yield and quality in certified organic apple production.

It is targeted at those producers who are contemplating or making the change from conventional to organic and those interested in reducing pest protection inputs.

- Every country, growing area and individual orchard and block within it has its own unique differences which greatly influence the ability of producers to maintain profitable organic production.
- Development of new allowable disease and insect controls has made organic production achievable by replacing previously used conventional/chemical inputs with an organically approved substitute. However this often leads to growers often relying on these 'silver bullet' replacement inputs rather than building robust sustainable interdependent systems.
- Organic apple producers can achieve similar yield, quality and cost of production to their conventional counterparts, in growing areas with specific natural advantages.
- In growing regions with a less favourable environment, producers often integrate a variety of marketing techniques in order to remain profitable. E.g. 'locally produced', pick-your-own, box schemes, farmers markets or value added processed products.
- A growing sector of the organic and wider farming community are taking a biological (nutrition) approach to improve plant and soil health, resulting in yield and quality improvements. Many companies both new and established are vying for the producer's dollar by providing products which promise to deliver these benefits.
- There is no worldwide blanket standard for organic production. Allowable inputs vary from country to country due to differing requirements of certification bodies and this creates difficulties if exporting to these markets.
- Research into organic production is impeded by not having the financial backing of large organisations. Economies of scale encourage research on a property and industry basis.
- Most research currently occurring is reductionist in nature, isolating individual components (developing and comparing single inputs for single issues) rather than taking into account the complex interwoven nature of holistic systems.

- Producers should know the market they are targeting and base their crop management on the end product their market requires.
- Producers should understand the strengths and weaknesses of producing in their locality and choose varieties / production systems that compliment the natural attributes that exist.
- When replanting in ground with suspected or known replant issues selection of rootstocks which are less susceptible could pay dividends.
- Weeds are inevitable when trying to maintain bare soil. When conditions allow, maintaining good ground cover crops under tree improves soil structure, reduces compaction, improves organic matter and humus levels, improves nutrient cycling and in the case of legumes can provide much of the apple crops nitrogen requirements.
- Water is the most important of 'fertilizers' and effective and efficient use of this vital resource is imperative. The use of new soil moisture sensors as a tool to avoid over or under application can help reduce tree stress, improving yields and quality.
- Organic growers worldwide would benefit from a greater awareness, education and emphasis on encouraging, balanced soil biology and plant available nutrition. Regular monitoring using plant sap readings as indicators of plant health, and monitoring changes to soil biology and structure can allow producers to recognize whether management practices are producing changes in the desired direction.
- Plant protection products, no matter how innovative or "organic", are really only covering up the symptoms of an unhealthy plant/soil. Access to these band-aid solutions may be necessary in the short term but sustainable results lie in addressing the underlying cause.

Growers need research, resources, advice, and supportive networks to encourage them when converting to biological organic production. They need to have confidence that issues which are specific or more dominant in organic production are being addressed with research. They need effective, organic allowable resources at hand should they be required. They need advice from experts who believe in biological organic production, are unbiased in the advice they give, and able to help producers implement a complete workable "system". They need access to networks of like minded producers to share experiences and grow their knowledge.

Introduction

The basic formula for producing organic apples profitably is no different to any other crop. It comes down one simple equation. **Profitability** equals **Yield** multiplied by the **Selling Price** less the **Cost of Production**. Unfortunately producing organic apples is not anywhere near as simple as this statement makes out. The complex nature of producing good organic apples requires a multi disciplinary approach which begins with a mindset change on the part of the producer, followed by a steep learning curve and never ending commitment to the process. The following report discusses some of the factors involved in maintaining profitability, focusing mainly on production issues, including some observations and examples of the innovation I encountered during my travels. It is not by any means a blueprint for organic apple production. Each country, growing region, orchard and block within it has their own unique differences which greatly influence which management techniques will be embraced. Producers need to make production and marketing decisions mindful of limitations or opportunities that these differences provide.

What influences Yield

The following list of variables can have a major influence on yield in apple orchards. Planting density, rootstocks, variety, weed competition, water availability, nutrient availability and type and timing of fertilizer application, thinning timing and effectiveness, pollination activity, previous seasons crop load, canopy management (encompassing pruning timing/severity, tree vigour, bud development, light interception and training system), tree stress due to natural or altered environment, and level of pest, disease or virus pressure. In any yield comparison between two blocks this list of variables need to be considered.

With all these factors coming into play and often interlinked the management decisions for a block of apples will greatly influence the yield achieved. By far the largest influence on yield in any orchard whether organic or conventional is the planting density. The more trees per hectare the greater the light interception and the greater the yield potential. So how does an organic block differ from any other? The main differences are in the areas of under tree management, thinning practices, tree and soil nutrition and pest control measures.

In many cases large modern 'industrial' organic orchards can be hard to distinguish from any conventional orchard. Aside from the ground treatments which are often the giveaway, to the uneducated it is often hard to distinguish one from the other. Where they differ is in the type of inputs that are allowed. Certified organic production does not mean that pesticides and fertilizer can not be used, it just stipulates that these should be from compounds that are naturally occurring with producers preferably developing improved cultural practices to limit the use of these 'natural?' inputs.

Replant issues

If planting in a block with replant disease issues, some organic orchardists in Washington State USA choose to take that block out of the organic system to allow chemical soil fumigation before planting and the use of uncertified planting material, then reapply for certification. By the time the trees are producing a viable crop the block is once again certified (3yrs). While not what might be regarded as ethical or in fitting with the organic philosophy it is common practice and meets all the requirements of 'certification'. The industry is looking for alternatives.

Research has been conducted in Washington State on the use of Brassica Seed Meal as an organic soil amendment, which when incorporated in the soil have been somewhat successful in controlling some of the causes of Specific Apple Replant Disease.

One project of great interest to the whole American apple industry is research which is being undertaken involving multiple states, testing rootstocks to select for replant disease resistance, while also selecting for preferred growth characteristics. Research is ongoing however early indications, with various rootstocks grown on two trial blocks in commercial orchards in Washington State, showed major differences between selections with some promising selections amongst them.

The photos on the following page show Fuji in a block with known replant issues. Trees are the same age with the one on the left being on M9 EMLA rootstock while the one on the right being on G4214 rootstock. Notice the difference in the quantity and quality of scaffold branches and next years cropping potential.

1 EMLA M9, Replant rootstock trial, Washington State

2 Geneva 4214, Replant rootstock trial, Washington State

Thinning Practices

Thinning practices can have a major influence on yield outcomes. Under thinning can result in poor fruit size, expensive hand thinning, and low return bloom and potentially resulting in biennial bearing. Over thinning will have a direct impact on yield with potential storage issues for the remaining crop. Lime sulphur (LS) is commonly used as an organic blossom thinning desiccant in most growing areas and its effectiveness is determined by climatic conditions experienced, applicator experience (local knowledge), level of flowering compaction and variety targeted. In Washington State LS mixed with a specific brand of Fish Oil is an industry standard which is confidently used by most orchardists organic or otherwise. It is well researched, well suited to their climatic conditions and achieves repeatable dependable results.

In general, apple thinning tends to be a site specific practice, making recommending products and rates almost as risky as applying them…

Typical rates and comments by various growers interviewed in USA were as follows:

<u>California</u>

Lime Sulphur (LS) 2% and Fish Oil (*NB containing emulsifier) 2% in 100 gallons/acre

Avoid slow drying conditions. Was OK for Cripps Pink but caused russeting on Fuji.

Washington State (East)

LS 4% whole tree at full bloom (FB) then at 2% just the tops with 2 days between applications

Washington State (Central)

LS + Fish Oil 2 to 3 applications at 20 to 80% bloom. Risk of russet increased on branches closest to the sprayer 'blast zone'. Risk also increases with larger droplet size so high pressure/ small nozzle is preferred.

Pennsylvania

2% LS 2% Fish Oil NB not effective at petal fall

Michigan

One orchard used salt for thinning. 3.5 lb salt in 60 gallons /acre Every 2 to 3 days. Up to 5 applications during flowering. (Fruit mainly produced for organic juice (cider) and hard cider. No hand thinning required.)

Although research is ongoing into finding other types of organic allowable solutions which are effective thinners, often as with conventional orchards, the reliance of the use of any product which requires application(s) at a certain time of flower/fruit development leaves the orchardist at the whim of mother-nature. With this in mind, two innovative thinning techniques well suited to organic production and worth considering when designing future plantings are:

- The Darwin fruit thinner which utilizes a mechanical method of removing flowers and is well suited to orchards with a narrow fruiting wall up to 1 metre wide. (Would be suited to most high density plantings) It has the major benefit of being effective regardless of weather conditions but can be affected by operator ability and experience. It is a cost effective method of thinning which is now being researched and used commercially in a variety of fruit types and many countries world wide.

3 Darwin fruit thinner, Interpoma, Italy

– The use of shading to encourage apple trees to shed a percentage of their crop is a novel idea which research has shown to have potential. It would be necessary to have a suitable tree shape and an easy method of application and removal of shade cloth such as the Crendon Machinery Net Whiz ™.

Hand Thinning

Many organic growers I spoke with were quite happy to hand thin. Their reasoning was two fold.

Firstly they would rather have a crop that they needed to hand thin than not have one. Thinning at flowering makes the assumption that the flowers that you see are going to set. This is not always the case, and pollination, weather conditions (affecting bee activity) and nutritional imbalances can cause poor flower to fruit conversion levels. Alternatively ideal nutrition and a well balanced controlled tree can naturally shed excess flowers / fruit and set an optimum crop.

Secondly many production areas visited around the world had insect pests that were damaging their crops during flowering or early fruit set. E.g. Bronze Beetle (NZ), Plum Curculio (East coast USA) and Apple Blossom Weevil (UK). By initially leaving on a larger crop than was required, this allowed them to hand thin off the damaged fruit, and still retain a sufficient crop load.

Hand thinning has two major drawbacks. Firstly the later thinning is completed after flowering the less the benefit on fruit sizing. Secondly hand thinning is an expensive time consuming task.

Working back from a desired yield, then counting fruiting buds prior to pruning in winter and pruning to reduce bud numbers (potential bunch numbers), is an effective starting point to reduce hand thinning required.

Under tree management

Managing weeds in an organic system is often seen as one of the biggest hurdles for producers when converting to organic. The type of under tree management undertaken will depend on many factors. These include the age and size of tree, system prior to converting, likelihood of vermin problem, insect issues, water availability and the producers approach to maintaining soil health, nutrition and structure.

There are many ways to suppress weed activity in an organic orchard other than hand weeding. Various methods have been promoted including flame weeding, steam weeding, hot foam, various methods of ploughing, mowing and cover cropping, artificial and natural mulches, the use of livestock (eg sheep, pigs, chickens), organic approved natural herbicides and even UV Light. Often a combination of methods will produce the desired outcome. The most commonly utilized methods I viewed on my travels were variations of mowing and ploughing.

Ploughing was the preferred option throughout most of USA. The majority of organic producers favoured ploughing due to the following reasons. It suited young trees and old, reduced impact by voles, destroyed insects/larvae in the soil, reduced competition from weeds for water and nutrients, and it helped to slightly improve soil organic matter by shallow incorporation of weed residues. The main negative for ploughing is the adverse effect it can have on soil structure. Many producers that I visited in USA were using an implement called the Wonderweeder™.

4 Wonderweeder, California USA

Producers commented that the benefits of being able to work at up to 8 mile/hr, being ground driven (so no hydraulics) and shallow working depth reducing soil damage, as reasons for choosing this implement over others. Research has shown this implement to be an effective mechanical device unless being used in a grass sod.

It is generally agreed that young trees require a largely weed free environment ensuring little competition for water and nutrients. Organic producers worldwide mostly use a combination of compost and mulch or when establishing young trees. Apart from reducing competition from weeds, this practice helps to increase soil biological activity, reduce soil temperature and increase water infiltration, as recognised recently in a report documenting trials undertaken in Queensland.

Once trees are established, the preference in the Hawkes Bay area of New Zealand amongst organic producers is to mow under trees. Producers commented that generally within two years of commencing mowing, that common broadleaf weeds such as Fat Hen (*Chenopodium*

5 Raised irrigation, Hawkes Bay, New Zealand

album), which had previously been dominant under trees, virtually disappeared and preferred cover crop species that were dominant in the planted inter-row area had largely replaced them. They suggested that the conventional practice of herbicides and attempting to maintain bare soil approach, encouraged these weeds. By mowing under trees and maintaining full soil cover organic producers had noticed great improvement to their soils.

Many of the large organic producers in the area had grown their businesses by leasing (mostly) or purchasing established conventional orchards and converting them to organic. A time consuming task in these older orchards often without trellis was to run a wire and suspend irrigation (poly-lines and sprinklers) off the ground, to enable under tree mowers to operate without causing damage.

Unfortunately this preferred practice of under tree mowing has had to be put aside in some orchards due to the increasing damage being caused by the Bronze Beetle (BB). BB was never really an issue in conventional orchards in the Hawkes Bay possibly due to the use of broad spectrum chemicals which kept numbers below noticeable levels. Over the last five years numbers of BB in some organic blocks have reached levels where producers are willing to try anything (organic allowable) to remove them. Some producers have begrudgingly resorted to under tree ploughing to break the lifecycle of BB. They recognize that their soil structure will be adversely affected, but until a better option is devised through ongoing research, they are attempting to reduce the damage being caused.

6 Under tree mower, Hawkes Bay, New Zealand

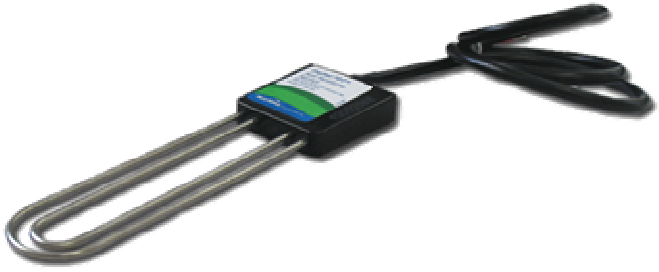
Water Availability

Water availability is an issue which should be given equal attention whether producing organically or conventionally. Most organic systems encourage building of organic matter in the soil by either shallow incorporation of cover crops or composts. By lifting organic matter levels you can improve the water (and nutrient) holding capacity of the soil. Also the biological activity of the soil will be enhanced improving nutrient availability. The trade off is that if cover crops are maintained year round they can compete with trees for available water (and nutrients) and this needs to be accounted for.

Adjustments to irrigation based on accurate monitoring of soil moisture levels can have major effects on yields achievable. Although some fruit growing regions often do not require irrigation due to reliable rainfall during the growing season, organic production usually does best in dry regions where disease pressure is minimised (but irrigation is required). Over irrigation can cause water logging stress and remove valuable, but leach-able nutrients (eg Nitrogen), from the root zone. Low soil moisture levels especially during flowering and fruit filling times can equally affect yields. Water is a valuable resource and the responsible use of water is gaining more attention as the effects of climate change and a growing population place strains on environmental flows. Increasingly producers are asked to justify and conserve the amount of irrigation water they use.

Acclima irrigation in Idaho have developed a closed loop irrigation system which although relatively new to production horticulture is showing potential with impressive (anecdotal) yield improvements being achieved simply by maintaining soil moisture within an optimal range. Research trials undertaken at the University of Florida on turfgrass have proven massive water savings are achievable utilizing this method. It does this by using specialized soil sensors connected to an irrigation controller which constantly monitors soil moisture levels and then adjusts irrigation timing to maintain soil moisture within a preset range.

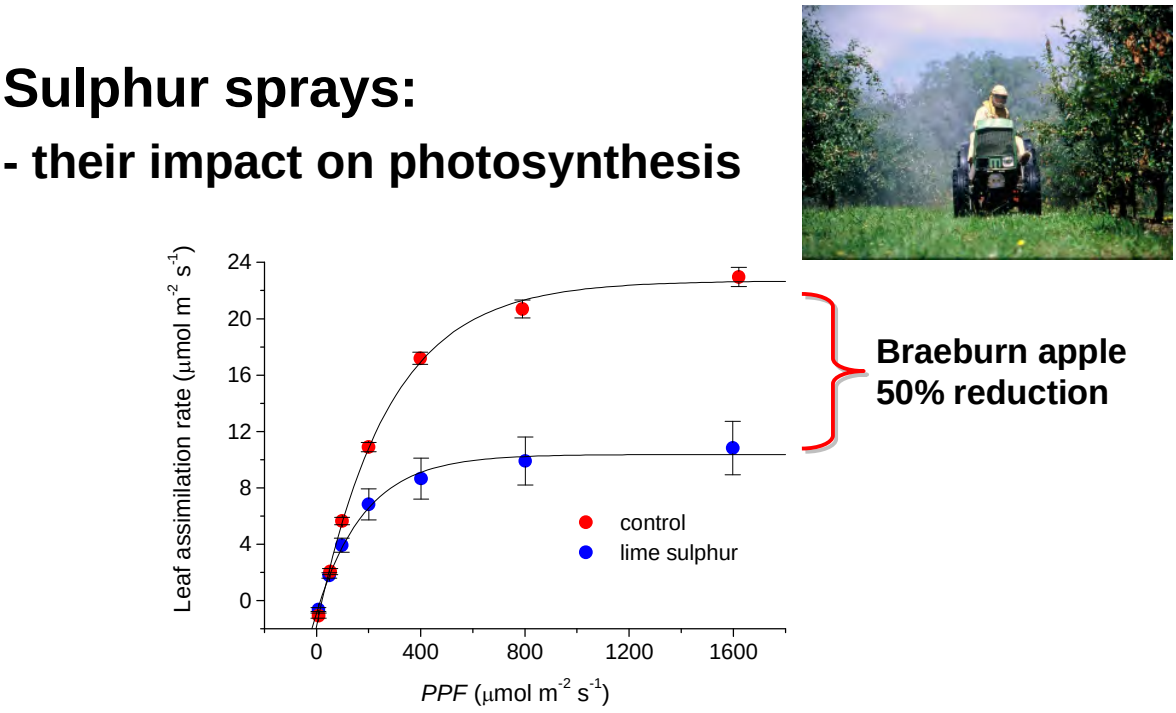
The sensor works on the same principal as Time Domain Reflectometry but has been designed to be effective regardless of the clay content or the electrical conductivity (EC) of the soil and readings are temperature compensated.



7 Acclima moisture sensor

Effect of Disease Control on Yield

Disease often affects the marketable yield of a crop as well as the harvestable yield, however sometimes the control of a disease can have a significant yield reducing effect itself. In the case of apple scab, the use of sulphur and / or copper is recognised to have a phyto-toxic affect on the leaves reducing their photosynthetic abilities and affecting fruit sizing and therefore yield. The potential for yield reduction will depend on the rates used, the number of treatments per season and the variety in question. Braeburn is particularly sensitive to sulphur phytotoxicity as shown in the following graph.



Graph 1 Research on effect of Sulphur, courtesy Jim Walker, Hort Research, Hawkes Bay, New Zealand

Finding reliable effective alternatives to sulphur for the control of apple scab is one of the keys to enable organic producers to achieve yields comparable to or better than their conventional counterparts. Interestingly some researchers did not appear to be that interested in trials involving only nutritional inputs aimed at removing the need for sulphur sprays.

Disease Resistant Cultivar

One solution which is widely used by organic growers worldwide (especially by those in less favourable climates) is to select from the growing list of apple cultivars being bred with varying levels of disease resistance. While some of the early selections which have been produced for many years were not the most appealing to the eye or palette, it appears that the current trend of plant breeders is to place greater emphasis on disease resistance when deciding which cultivars will make the grade. One selection originally from USA, Juliet® which was being promoted to organic producers at Interpoma was specifically marketed as an organic apple, requiring producers to be certified organic to enable them to secure trees from the nursery.

8 Organically Exclusive Juliet ® at Interpoma, Bolzano, Italy

Canopy management

Canopy management does not vary significantly between commercial organic and conventional orchards. Organic orchards are often considered as less vigorous than their conventional counterparts, but this was not observed in many of the organic orchards that I visited. However organic managers will often try to promote a more open canopy to improve airflow and reduce fungal disease pressure.

Although I did view many new dwarf plantings throughout the world, many organic orchardists showed a preference for a medium to large tree size with the bias often based on wanting a strong root system to maximise the area over which nutrient uptake is carried out. Another benefit of a larger tree was the shading out effect on potential under tree weed growth. The trade off is that these larger trees will not suit the new thinning techniques discussed earlier.

Correcting past mistakes

Fruit growing or any permanent cropping system makes correcting of soil imbalances a difficult task. Mistakes from previous years have ongoing repercussions. When converting from conventional production to organic the most important area to address is the soil. Often conventionally managed blocks are found to have diminished soil life both macro and micro, low beneficial fungal levels, and major imbalances of nutrients. In extreme cases the soil could best be described as dead, as appeared to be the case in one conventionally managed cherry orchard I visited in Holland. Much of the orchard was planted in a glasshouse previously used for tomato production. Years of herbicide application had left the soil compacted, totally free of worms, with only moss and lichen (early colonising plants) growing between the trees.

9 Untreated "No worms here"

In this state the soil was mainly acting as a support medium for the trees and nutrients were supplied in a way that resembled hydroponics. The grower was widely regarded as having good quality cherries but had recognised that improvements could be made and agreed to a small trial being undertaken. Stephan Timmermans, a well respected Dutch biological consultant, had visited the property three weeks prior and had worked with a few trees to try to address the lack of biodiversity in the soil. He had incorporated high quality fungal dominant compost into the soil and used shredded tree root mulch around the base of the trees.

10 Treated "Stephan – encouraged by results"

The results after three weeks were impressive. Very high numbers of young worms had colonised the area and the soil structure had noticeably improved. What this demonstration showed was the resilience and forgiving nature of soil, to be showing signs of recovery so quickly after changes were implemented, after years of destructive practices. On seeing these results the orchardist was eager to implement this practice over the whole orchard.

Compost

Compost, while a valuable organic input in this previous instance, can vary greatly in quality and therefore effectiveness. Good compost provides numerous benefits for the soil including increased nutrient and water holding capacity, improved soil structure and food and shelter for beneficial organisms. Initially it would be unrealistic to rely solely on compost to provide for the nutritional demands of the crop. Best results can be attained by mixing additional nutrients with the compost before spreading. If possible shallow incorporation of compost is advisable, however this may only be possible if planting orchard or if ploughed strips are maintained. Many producers now apply variations of compost "teas" which can also vary greatly in quality and effectiveness. If requested reputable suppliers should be able to supply records for:

- Nutrient analysis
- Biology levels present. Fruit trees prefer a fungal dominant soil / compost. A detailed description of what you should look for can be found on the Soil Food Web website.
- Temperatures maintained during treatment to ensure pasteurisation of unwanted viable weed seeds, plant pathogens or pests in the compost has been achieved.

11 Top Left Compost turning, Van Iersel Compost, Biezenmortel, Netherlands
12 Top Right High fungal compost for compost tea, Joel Williams, UK Soil Foodweb Lab, Laverstoke Park, England
13 Bottom Left Maintaining adequate moisture, Rick Trumbull's Sustainable Soil Solutions, Oregon, USA
14 Bottom Right Checking Compost Temperature, Emerald Farms, Washington State, USA

Nutrient Levels

Soil nutrient levels in some orchards I visited were not given enough attention. Soil testing was not done annually and symptoms of nutrient deficiencies often showed in what I would have considered to be some of the most naturally fertile soil types available. This complacency is possibly a result of farming naturally fertile soils rather than an organic anomaly.

When questioned as to what the available Calcium levels were in their orchards soils, many growers commented that their soil pH was good, at levels between 6 and 7. They were not usually aware that soil pH is not a reliable indicator of Calcium levels. It is actually an indicator of the level of Hydrogen ions on the negatively charged soil colloid. At a pH of 7 there are virtually no H+ ions on the colloid having been replaced by other cations. The problem is that the Calcium ion is competing for space on the soil colloid with Magnesium, Potassium, Sodium and other cations and the ratio is all important. Different ratios can still give the same pH reading, therefore soil pH is NOT a reliable indicator of available Calcium.

It is often contended that organic orchards will not be able to achieve yield levels of their conventional counterparts simply due to reduced nutrition provided by organic composts or fertilizers. Just because a crop is being farmed organically doesn't mean nutrient requirements can be neglected. The difference being that these nutrients need to be supplied in an organic allowable (naturally sourced) form or provided to the plant through soil biological activity.

Other than thinning issues or detrimental effects of sulphur (or copper), the main reason why yield would be affected is if sufficient nutrients were not available to the crop. Leaf or fruit analysis should be utilized to ensure crop requirements are being met. Supplementing nutrient deficiencies via fertigation or foliar applications will often be necessary especially during the transition to organic while balancing soils and improving levels of soil biological activity.

Pest and Disease Control Strategies

Many organic producers around the world are farming using a replacement based approach, utilizing organically approved inputs to contend with known pest and disease issues. In recent years, the introduction of many more effective approved inputs has enabled organic producers to maintain better control of pests than previously possible. Some of these control measures can often be found in conventional orchards. E.g. Mating Disruption and specific viruses for Codling Moth and other species, Kaolin Clay for chewing insects, Spinosad and Bacillus Thuringiensis for leaf rollers, caterpillars and others.

Thermal Pest Control

One innovative insect and disease control measure which is being used in Washington State and at Sunshine Fruit Farms in Northport Michigan, owned by Bob Weaver, was a Thermal Pest Control or TPC machine developed in Chile. The PTO powered machine towed through the orchard at 5km/hr momentarily blasts trees, with LPG fuelled, 100 deg Celsius hot air, reportedly killing fungi and insects and boosting the plants own defence system.

15 Using TPC on Cherries in Chile.

Bob said he had achieved effective control of Plum Curculio, Aphid, Leaf Hopper, Mites, Leaf Miner, and Apple Maggot insect pests in the first season of use. While he had not achieved total disease control utilizing the TPC he was happy with the results thus far. I observed a comparison of treated and untreated tart cherries in his orchard at the end of the season and foliage health was noticeably better on treated trees even though he had commenced treatment partway though the season. Best control is said to be achieved with treatments done each week through the growing season and producers lease machines on an annual basis. Research surrounding the use of the TPC is ongoing and results can be obtained from their website along with an Australian contact.

16 Untreated tart cherries, Sunshine Fruit Farms MI USA

17 Treated tart cherries, Sunshine Fruit Farms MI USA

Turning Pests into Pork

Another innovative approach to not only insect control but also weed management on Jim Koan's 180 acre organic orchard in Michigan was the strategic use of pigs. Initially the reason for using pigs in his orchard was to clean up fallen immature fruit from the orchard floor to break the life cycle of the Plum Curculio. Plum Curculio is a major pest in organic orchards on the East coast of USA, with relatively few organic approved controls available, which can cause huge economic damage. They worked better than expected removing 98% of the fallen fruit. Trials done in one part of his orchard showed 3% damage by Plum Curculio where pigs were used compared with 15% damage in the control. Jim said that levels of Codling Moth also appeared to be reduced but further trials were required to verify this.

The other benefit that the pigs provided was shallow incorporation of weeds and other plant matter under the trees. Jim said that trials would be continued next season to try to ascertain the best stocking rate. Michigan State University researchers, funded by a USDA grant are working with Jim to monitor and document trial results. His initial trials showed that the (27) pigs could only be left in a (1 acre) block for a maximum of 3 days before needing new ground otherwise they caused too much damage. They would first concentrate on the softer ground under the trees but if left in longer than 3 days the whole orchard floor would quickly become ploughed. The pigs would also need to be removed by autumn as they tended to rip up the ground too much when the soils were saturated, damaging soil structure. He volunteered that 25 to 30 pound pigs (10 wks old) achieved the best results.

18 Jim Koan's Cider plant, Flint Michigan USA

Jim came up with his idea of using 'Hogs' in his orchard after attempting using chickens, then guinea fowls and then reading about how Australian organic producers would often use sheep in their orchards during the dormant period to control weeds and clean up after harvest. He remembered how his grandfather would allow his pigs to run through the orchard on occasions. An added

19 'Hogs' devouring apple pulp from juice process

benefit of the pigs was the marketing of organic pork. The use of pigs in Jim's orchard fit with his sustainable philosophy. Jim is able to profitably produce apples for alcoholic cider production and is gearing his production accordingly. The on farm 'Hard' cider production commenced 3 yrs ago and the Organic certified cider is now marketed in 33 states. The pigs get to eat the pulp from the cider milling process and help to return some fertility to the orchard with their manure.

A Biological Approach

Biological farming advocates view many insect species as nature's garbage collectors, responsible for removing unhealthy plants from the ecosystem. As Dr William Albrecht put it, "Insects and disease are the symptoms of a failing crop, not the cause of it. It's not the overpowering invader we must fear but the weakened condition of the victim." This view is supported by Dr Philip Callahan author of "Tuning in to nature" and numerous other publications when during his research he discovered that insects are attracted by plants under stress which literally signal insects to devour them.

Many organic apple producers I visited were aware of and interested in the biological approach to growing. Some had attempted to implement some components of a biological system with variable success. Very few producers worldwide were able to successfully demonstrate a working system where healthy crops were produced without insect or disease damage simply and only though the use of nutritional products and maintaining maximum tree and soil health.

Those that were successful claimed to be achieving insect damage levels of around 1%. They had a nutritional programme custom designed for each block based on regular monitoring and the scheduled use of a variety of specific inputs.

Those who had attempted but were yet to achieve it had issues with the generalized nature of the agronomic advice they received. Producers often displayed a basic understanding of biological farming but either lacked confidence in the system, lacked access to all the necessary components or a full understanding of the interactions between them. Often due to the cosmetically perfect demands of their market, producers were so highly focused on protecting their crops from impending damage by insects or disease that they found it difficult to maintain a focus on nutrition and invariably intervened with control products. This further reduced the overall tree health and system balance, and they found themselves back in the old habits of fighting individual symptoms in a replacement organic approach. Some producers

had issues with the lack of understanding that some advisors showed regarding the threat of crop specific pests. Producers need more support from advisors for the best course of action to take if their soil/plant health is not yet at the required level and economic pest or disease damage is likely. The first rule for attaining sustainability is being profitable and staying in business. The main issue for growers is that while they may need short term survival tools at hand, they should not lose sight of their long term objectives.

Practical Advice for producers taking a biological approach.

The best advice I could give would be to educate yourself as much as possible on the complex natural processes involved and then if possible find a good biological agronomic advisor with a proven track record in your crop and region, that you can work with.

The Importance of a Balanced Soil

The next step is to **balance** soil nutrient levels based on previous seasons leaf testing and current soil test results. (A good overview of the various soil tests and how they fit in a biological system is described in the 2007 completed report by Nuffield scholar Catherine Harvey.) Balance is the key here, as can be seen on a more complex version of Mulder's Chart, depicting soil nutrient interactions, oversupply or under supply of one mineral can influence others. The level of organic matter, humus and biological activity in a soil will have a stabilizing effect on nutrient levels such that the higher the humus levels the less critical the ideal ratios.

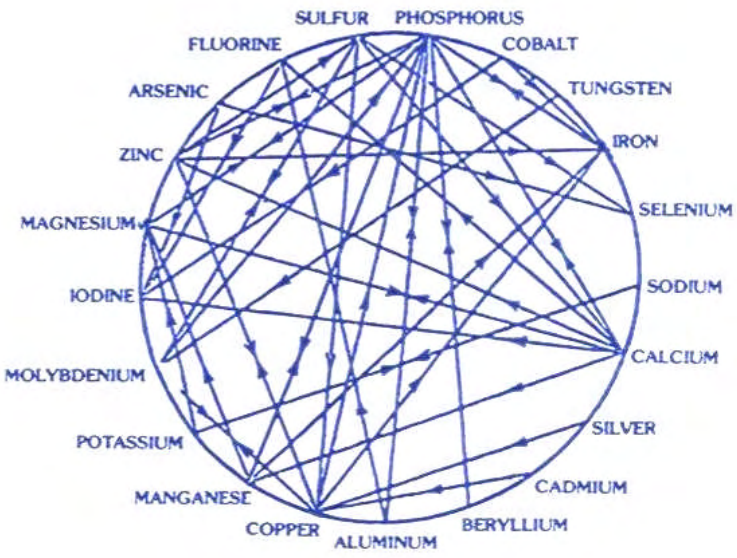


Chart 1 Mineral Interrelationship

Encourage a large root system

A large root system would appear to be favourable in a biological system. A large root system can act as a reservoir for nutrients as well as allowing for greater interaction with soil biology and nutrient uptake. If trees have a dwarf rootstock then establishing an environment in the root zone which favours mycorrhizal fungi and establishing a monitoring program to

determine the level of root colonization and improvement over time, will assist the trees ability to uptake nutrients especially in low fertility soils or where available phosphorous is low by effectively increasing the roots surface area. Use irrigation systems where climate necessitates that cover maximum area so that both tree and existing biology are not limited in the area they can access due to lack of moisture.

Managing biology

Microbes are the bridge between the soil and the plant. In an organic system, without access to soluble commercial fertilizers, plant roots rely on soil microbes to make nutrients available to them. In exchange for the nutrients plants feed about 30% of total sugar production to the root zone microbes, varying the exudates to encourage specific microbe groups, based on the particular point in the crop cycle they are at. Eg favouring nitrogen fixers to supply nitrates for vegetative growth. The soil foodweb needs to be well fed, well mineralised and protected from toxins. The soil foodweb includes algae, bacteria, fungi, protozoa, nematodes, earthworms and arthropods. With every component of the web having a different part to play, diversity is the key. Encouraging existing populations native to your soil is one option but if previous chemical and fertilizer practices have destroyed these then it may be necessary to repopulate with commercial inoculants or compost tea brews. In an orchard situation where we are trying to encourage a more fungal dominant soil this can be assisted with under tree applications of complex compounds such as humic acid, kelp, fish and compost derived from woody materials. This should be balanced with some bacterial foods in the form of simple compounds such as fulvic acid, molasses and green manuring. Monitoring biology levels and ratios in your soil at least annually can help you to understand if your system is moving in the right direction.

Prepare a season in advance

Set the tree up by the end of season with maximum nutrition before trees shut down over winter. When trees break dormancy they initially rely on nutrients, especially Nitrogen stored in the buds. The nutrition the tree receives this season will greatly influence the start next seasons crop gets. Trees remobilize the Nitrogen stored in perennial tissues which can account for almost the entire Nitrogen requirements of the flowers and spur leaves (at flowering).

Monitor Tree Health

Monitor tree health by testing plant sap from the youngest fully developed leaves. First popularised by Carey Reams and now promoted by published biological agriculture leaders Dr Arden Anderson, author of "Science in Agriculture", Phil Wheeler, "Non-Toxic Farming", Graeme Sait, "Nutrition Rules" and many others is the use of monitoring plant sap for brix (soluble solids) levels with a refractometer. The theory being that the higher the brix reading the healthier the plant and the less susceptible the plant is to insect attack. This concept is widely promoted and used in biological agriculture although there has been little peer reviewed research published to date. Some of the researchers I spoke with about testing plant sap to determine plant health had heard of producers using the method but were not planning to conduct research into it, either because they could not find any prior research findings for a starting reference or because in order to undertake research they required funding….

My experience with the use of sap brix testing in apple (leaves) has sometimes given variable results. Trees which have been stressed for water will often show higher brix readings when in fact the health of the tree is suffering. Brix levels will also vary dependant on the weather conditions and time of the day as a result of photosynthesis levels. Brix levels should drop overnight and if it doesn't then this could indicate a plant available Boron shortage.

The use of a refractometer can also indicate whether sufficient Calcium is in the sample. A clear straight line indicates low Calcium whereas a fuzzy line indicates sufficient Calcium present. Brix testing should be done at the same time each day if wishing to track changes.

High brix levels in plant sap translate to higher brix levels in fruit. Fruit trees concentrate sugar in the fruit as they mature. Brix levels in fruit are one of the maturity indices used by producers to determine when to harvest, and discerning markets have set targets that producers must meet. The consumer indirectly influences these target levels and their eating experience is improved by higher brix levels. Storability and shelf life is also improved providing levels are not high due to fruit being "over" mature.

One use of brix which is widely promoted is testing of foliar nutrient sprays to determine the likely benefit to the crop. After taking a sap sample from a tree showing low brix levels, and treating only that tree with the intended nutrient spray, a further sample can be taken after a short duration and if the Brix level has improved by at least 2 then it is argued that the said nutrient spray will be beneficial.

Plant sap can also be tested for pH with the ideal level being 6.4. Testing plant sap for pH was first promoted by American researcher Bruce Tainio and has rapidly been taken up around the globe in biological farming circles as a useful indicator of plant health. If plant sap pH exceeds 6.4 then the most likely cause will be an anion imbalance (Phosphate, Nitrogen or Sulphur). At pH 8 the chance of insect attack is said to be 100%. Alternatively if the pH is below 6.4 then the plant is likely to have a cation imbalance (Calcium, Magnesium, Potassium or Sodium). At a pH of 4.5 the chance of disease attack is said to be 100%.

Other plant sap monitoring meters which are promoted by biological farming advocates includes conductivity, which indicates the level of simple ion uptake and plant sap meters for Nitrogen, Potassium and Sodium.

By utilizing these resources together producers can get a picture of what is happening with their tree health, to enable them to adjust nutrition programmes accordingly, providing they are prepared to commit human resources to ensure the testing is done regularly and properly.

Extracting plant sap from apple leaves can be a difficult task requiring specialized equipment. A two stage hydraulic or screw press will provide sufficient sap from a hand full of leaves to run all the above tests.

20 Using plant sap tools to monitor plant health.

All instruments and presses can be obtained in Australia from www.themeterman.com.au or www.nutri-tech.com.au

The various types of monitoring of plant sap while very useful should not necessarily take the place of soil testing and comprehensive leaf or fruit analysis, and at the end of the day more important than any test is being aware of what is happening in the orchard and how well the harvested crop meets the expectation of the producer and ultimately the consumer.

BioAg New Zealand Nutrition Based "Biological" Trial

While in New Zealand I had the opportunity to visit a small trial that is being carried out on a commercially leased orchard in Hawkes Bay. Green Planet Organics, who lease and manage the block agreed to allow Nick Pattison and Steve Haswell from BioAg (NZ) to trial their products on a small block of 59 Braeburn trees and compare the treatment results with 60 Braeburn of the same age, separated by 30 metres of bare land, that were managed under a typical replacement organic 'standard' programme.

21 Nick Pattison checks brix levels in trial block

The purpose of the trial is to assess the ability of a BioAg programme to supply nutritional requirements and control pests and diseases, without using any of the typical organic control measures currently used in the majority of New Zealand organic orchards.

It is important to note that this is the first year this programme has been undertaken and it is expected that a second year of treatment and comparison will be carried out to see if results can be replicated and based on previous experience, improved upon. Prior to the trial being undertaken trees in the two comparison blocks had been managed identically.

Independent monitoring of the two blocks is being undertaken by Agfirst. (Agfirst is the New Zealand company contracted by Apple and Pear Australia Limited to provide consultancy services to the ongoing Future Orchards 2012 project in Australia.)

At writing this report, the fruit from this first season, is yet to be harvested. So far two progress assessments have been carried out with a further one to be carried out prior to harvest and one when fruit is packed out.

The BioAg liquid biological products were applied using a less than adequate sprayer compared with that used on the standard treated trees, which may have influenced coverage and penetration of product. From the 8th of December on all foliar applications were carried out with an airblast sprayer.

In a summary from the assessment on the 26th of January 2009 by Jonathon Brookes, Technical Services Manager with Agfirst, the following points are made:

- BioAg treated trees had a 25% higher average number of fruit per tree (not statistically different due to variability between individual trees)
- Even with a greater crop load on BioAg treated trees, fruit size was not statistically different. The average diameter for BioAg treated fruit was 57.1 mm and the average diameter for standard organic fruit was 57.7 mm
- BioAg treated trees had significantly better leaf condition than the standard treatment. BioAg treated trees had an average leaf condition rating of 3.5 compared to 2.9 for the standard organic trees. (Based on a 0 to 5 system of rating leaf health)
- Fruit blackspot levels were significantly higher in the BioAg treatment, with fruit levels at 3.35% compared to 0.0% for the standard organic treatment.
- Leaf blackspot levels were not significantly different with the BioAg treatment at 0.10% infection compared to 0.0% for the standard organic treatment.
- Scale levels on fruit were significantly higher in the standard organic treatment at 1.80%, compared to 0.45% in the BioAg treatment.
- This was the same with codling moth. Fruit codling moth levels were 3.30% in the standard organic treatment compared to 1.00% in the BioAg treatment.
- There was no significant difference in leafroller levels in fruit or leaves between the standard organic treatment and the BioAg treatment.
- Elsinoe levels were also not significantly different on either the fruit or leaves between the standard organic treatment and the BioAg treatment.
- Woolly apple aphid levels on the leaves were significantly higher in the standard organic treatment at 0.90% compared to 0.10% in the BioAg treatment.
- Russet levels in the BioAg treatment were significantly lower that in the standard organic treatment. Average russet level in the BioAg treatment was 0.4% compared with 13.3% in the standard organic treatment.

In a conversation with Jonathan Brookes in February, he said that initially he was somewhat apprehensive and coming from a chemical background was sceptical about the trial being undertaken. Having seen the comparison to date he is now less biased in his thinking but is still sitting on the fence until the next assessment prior to harvest. He said that he was very interested in the trial and impressed by the general plant health and the excellent fruit finish being achieved. He said that the programme did not have total control over black spot and

would be interested to see how this progressed in light of recent rainfall events. He offered that the trial would have benefited from also having a no treatment "control" block as a comparison and suggested that this might be implemented next year.

The greater crop load on the BioAg treated trees is more than likely due to the thinning effect and level of tree stress caused by using Lime Sulphur on the trees in the replacement organic treatment.

The BioAg programme appears cost effective when compared to the full replacement organic programme and under a BioAg programme other nutrition inputs (compost, seaweed, molasses, foliar feeds etc) are usually not required. Other than following a specific programme of three BioAg proprietary blended products applied a little and often, Fish is the only other product which has been utilized. (NB. One oil spray and two copper sprays were applied in all blocks in August/Sept prior to deciding to commence the trial, and a second oil spray in Sept to counter a pre-existing scale issue affecting all Braeburn in the orchard.)

To reduce the need for hand thinning, and if the percentage of fruit with Black Spot is considered too high by the orchard manager, a minimal programme of wettable sulphur, over six weeks, commencing at the green tip stage of flowering may be considered in future years.

22 Steve Haswell tests for soil compaction using hand held penetrometer

In November, when I visited the trial, both sap brix levels and soil compaction readings, (measured with a hand held penetrometer), showed improvements in the BioAg programme over the replacement organic block.

The results which have been achieved so far while not yet conclusive, are very encouraging and it will be interesting to see how the trial progresses. Hawkes Bay in New Zealand has very good growing conditions for apples including soils which are generally naturally superior to most Australian soils and good rainfall and reliable irrigation. The effectiveness and response of the soils to the BioAg biological inputs is likely to have benefited from these growing conditions.

BioAg is an Australian company based in NSW who "market a range of biologically–active nutrients and programmes that help to produce a living, healthy and balanced soil for optimum plant and livestock productivity."

Price Influences

Price received in the apple market is no different to any other market in that it is largely a factor of supply and demand. Demand can be influenced by many factors including, variety, quality and marketing/promotional strategies. Ability to store apples to spread supply to meet demand will also determine price received.

Defining Quality

"Quality" is largely defined by the expectations of the customer (or at least middleman) that we are producing for. Most markets for fresh apples (not processed) have specific requirements with regards to size, colour percentage, defect levels (pest and disease damage), and maturity. Fruit not meeting the preferred fresh markets quality parameters will be downgraded with a consequential reduction in price received. Internal quality is often only referred to when determining storage-ability or looking for internal defects such as water-core, internal browning and internal rots. The focus is largely on what we don't want internally, rather than what we do want. Flavour is rarely the focus of marketers and levels of nutrients contained in mature apples are usually either not tested, or primarily tested in order to determine if the fruit will last the distance, rather than if the fruit is delivering nutrition to the consumer. The old saying "An apple a day keeps the doctor away" has been largely replaced by industry with "An apple a day keeps us in business". While it is true that people will at first buy with their eyes, if you want repeat purchases you have to deliver on eating experience expectations.

Producing and Marketing Nutrient Dense Fruit – Beyond Organix

In USA, for the last hundred years, basic foods have been tested for the levels of nutrients, and this information is recorded and made available to the public through the USDA's National Nutrient Database for Standard Reference On comparing the levels for "Apples, raw, with skin" (Based on analytical data for red delicious, golden delicious, gala, granny smith, and fuji varieties.), even over the last 14 years changes to the levels of nutrients found in the fruit have occurred. Levels of Phosphorus and Sodium have increased while levels of Manganese, Copper, Potassium, Iron, Calcium, Vitamin C and KJ of energy contained have all reduced.

Mark Nakata, managing director of Cal Tree Ripe has worked with biological advocate, soil consultant, surgeon and author Dr Arden Anderson since 2004 under the Beyond Organix banner, believes that often conventional farmers rely on "save me's" rather than good

management. He says “Farming organically is like any other farming, just with a different set of rules. More difficult because you must stay on top of everything. There is no safety net.”

Based in California, near Fresno, Cal Tree Ripe is focused on producing nutritionally dense fruit, and marketing through retailers to consumers, testing nutrient levels annually. They are so confident that consumers will respond favourably to the flavour of their nutrient dense produce, they guarantee to lift the throughput of the stores that decide to handle their product. They grow 600 acres of fruit and market a further 600 acres which is produced to their exacting requirements. They currently market approximately 1 million cartons under their programme with a diverse range of products including nectarines, peach, plum, apriums, melons, tomatoes, apples, citrus, berries, grapes and raisins.

Their production programme is not only focused on making available to crops, balanced ratios of nutrients in sufficient quantities, at the required timing but also providing technical know how in all areas of production from cultural practices like pruning, to plant health and pest monitoring. It is a team effort more than a top down approach. Their programme is not limited to sourcing specific products (inputs) from one supplier but rather on achieving the desired results by utilizing the best suited, most cost effective inputs. This differentiates Beyond Organix from many other grower groups in that the growers pay for the advice they get through a marketing commission rather than having it build into the price of inputs.

They favour Rhizobia inoculated legume cover crops between rows (eg vetch, beans) to lift organic matter levels and supply some nitrogen requirements. They also recommend a lower planting density than is promoted by the majority of industry, preferring trees to have a larger root system. They work with their producers to have a management plan in place from the start of the season (immediately following the harvest of previous crop) so producers are aware of expectations and prepared for implementation of the programme.

During the growing season crops are monitored for insects twice per week by the groups consultant and they average only 1% insect damage.

The nutrition requirements of their crops are determined using constant monitoring. Each block is treated individually with a preference for ground or fertigation (fertilizing via irrigation) application over foliar treatments. The results they are achieving have made their product very sought after in the market and their programme equally sought after in grower circles. Programme specifics are treated as intellectual property with producers needing to commit to the programme before details are divulged.

The produce is marketed as a niche product through selected retailers and smaller chains. They try to offer exclusivity where possible with heirloom varieties and gift packs. They distinguish

their product from other suppliers commodity lines with promotional and educational information for consumers and avoid selling through the major chains.

Growers receive ongoing training and the group hosts an annual symposium with microbial, soil and nutrition expert speakers. They carry out 8 to 12 field trials each year working with university extension agencies and various input providers to continually improve their production techniques and the nutrient levels in their product.

Maintaining Quality Post Harvest

Mitigating the effects of Ethylene in Cool Stores

Over the past 10 years conventional apple producers have increasingly used 1-Methylcyclopropene (1-MCP) marketed as SmartFresh ™ to stop the natural ripening process that ethylene causes in fruit. Released in sealed rooms containing produce the gas (1-MCP) blocks the ethylene receptor sites on fruit and significantly slows down the ripening of the fruit. Research has shown benefits to producers are increased storage and shelf life, superficial scald control, higher pressure levels compared with non treated apples, reduced levels of rot and maintenance of malic acid levels and background colour levels of apples (reduced yellowing and greasiness).

1-MCP is not allowed in an organic system, so another way to reduce the ripening effect that ethylene has while fruit is in storage is to prevent ethylene from building up in the cool room where organic fruit is stored. Two options for reducing ethylene in an organic system follow.

Ethylene Absorption with Potassium Permanganate Impregnated Pellets

One company supplying systems which are being utilized by many organic producers, wholesalers and retailers in 48 countries worldwide is Bioconservacion. Their Bi-On system uses potassium permanganate impregnated in zeolite clays, housed in disposable cartridges which when positioned in the airflow of coolroom fans adsorb ethylene from the air. Results from recent independent testing show this method of reducing the negative effects of ethylene in storage compares favourably with 1-MCP and although not conclusive, indications are that reduced levels of rots compared with 1-MCP may be achieved. Cost in Australia, when calculated back to a per bin basis, is similar to the cost of using 1-MCP, based on a preliminary quotation, but dependant on the length of storage time. Once fruit is removed from the storage area where ethylene scrubbers are operating the ripening process will continue.

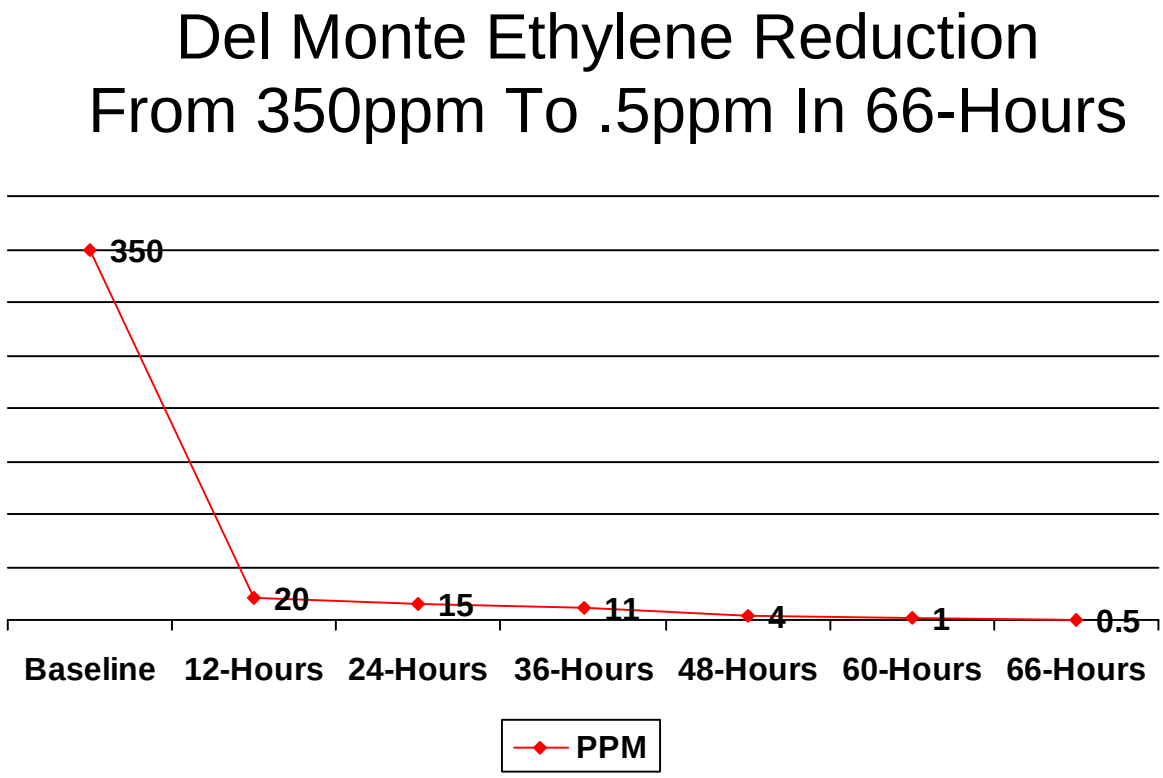
Photocatalytic Oxidation of Ethylene

Another system which is being used to deal with ethylene in cool stores is the AiroCide® Photocatalytic range of Air Purifying Systems. The Photocatalytic oxidation (PCO) technology behind these systems originated when NASA needed a way to remove ethylene from the artificial environment being used for vegetable growth experiments as part of its extended space flight research.

The patented technology utilizes the combination of a titanium dioxide photocatalyst, used in the PCO process, and ultra-violet light to kill and decompose airborne pathogens, such as bacteria, mould, fungi, viruses, and oxidise volatile organic compounds (such as ethylene gas).

The main advantage of this system over other technology available is that it is not a filtering system so there are no ongoing filter replacement and disposal requirements. (Annual replacement of UV tubes is required). This makes this an extremely cost effective, easy to use option for dealing with many storage issues whether the product is organic or otherwise.

The following chart was provided by a current user of Airocide® Technology which shows the capability of the unit to reduce ethylene to below the 1ppm target.



Graph 2 Ethylene Reduction using Airocide (R) PPT Courtesy of KES Science & Technology Inc, Georgia

Cost of production

When changing from conventional to organic the main changes in costs are related to the type of fertility inputs that are used, the type of pest control inputs used, the quantity of hand thinning required and the type of under tree management implemented. All other costs should remain consistent with those of a conventional grower besides initial outlay for changes required to existing irrigation system or capital expenses for under tree mowers or cultivators.

The Potential of a Favourable Climate

When it comes to producing organic apples, Washington State USA, undoubtedly have some of the best natural conditions conducive to replacement style organic production in the world. Their semi-arid environment with minimal insect and disease pressure has allowed organic production to flourish. It continues to expand and is predicted that as much as 20% of apple production in the largest apple producing state in USA will be certified organic by 2010. The varietal mix of organic production in Washington State is similar to conventional production.

23 Native flora alongside 500 acres of 13 year old organic orchard, Broetje's near Pascoe, Washington State, USA

I had the opportunity to see a presentation by David Granatstein on the Washington State organic apple industry at Interpoma 2008 in Bolzano Italy. His data shows that organic producers in Washington State are achieving similar production costs, equivalent yields, and better packout rates for the same grades out of mid to long term storage than their conventional counterparts.

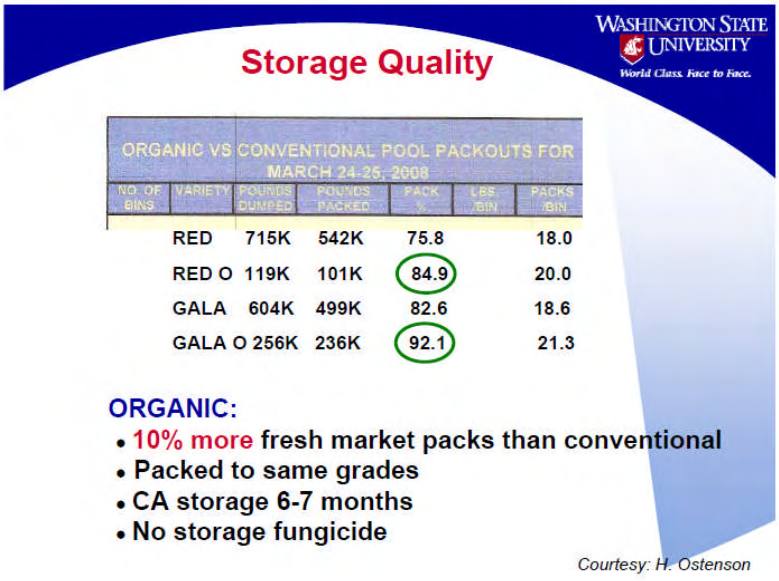
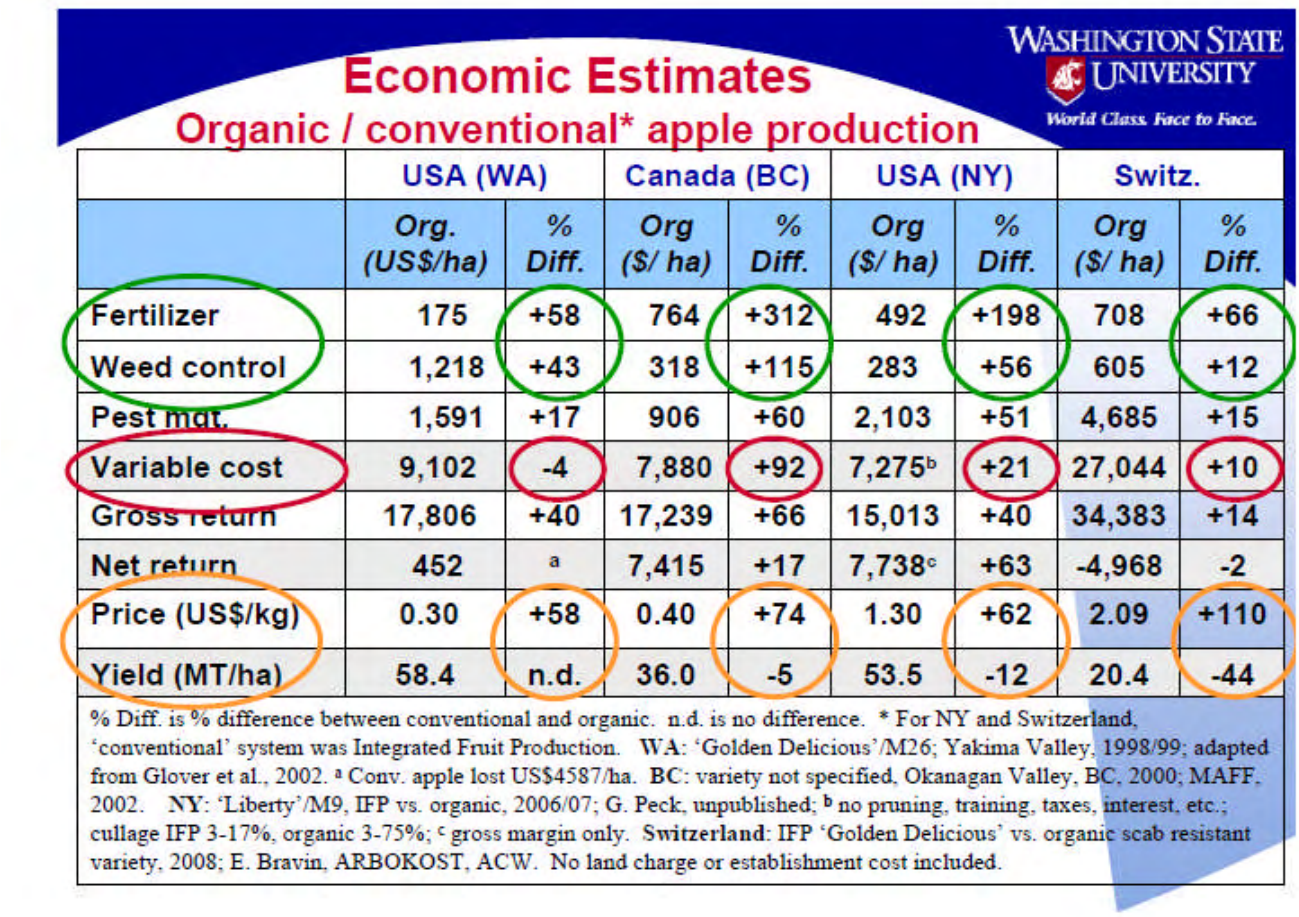


Table 1 Packout comparison, courtesy of David Granatstein WSU USA



Economic Estimates

Organic / conventional* apple production

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

	USA (WA)		Canada (BC)		USA (NY)		Switz.	
	Org. (US$/ha)	% Diff.	Org ($/ ha)	% Diff.	Org ($/ ha)	% Diff.	Org ($/ ha)	% Diff.
Fertilizer	175	+58	764	+312	492	+198	708	+66
Weed control	1,218	+43	318	+115	283	+56	605	+12
Pest mgt.	1,591	+17	906	+60	2,103	+51	4,685	+15
Variable cost	9,102	-4	7,880	+92	7,275[b]	+21	27,044	+10
Gross return	17,806	+40	17,239	+66	15,013	+40	34,383	+14
Net return	452	[a]	7,415	+17	7,738[c]	+63	-4,968	-2
Price (US$/kg)	0.30	+58	0.40	+74	1.30	+62	2.09	+110
Yield (MT/ha)	58.4	n.d.	36.0	-5	53.5	-12	20.4	-44

% Diff. is % difference between conventional and organic. n.d. is no difference. * For NY and Switzerland, 'conventional' system was Integrated Fruit Production. **WA**: 'Golden Delicious'/M26; Yakima Valley, 1998/99; adapted from Glover et al., 2002. [a] Conv. apple lost US$4587/ha. **BC**: variety not specified, Okanagan Valley, BC, 2000; MAFF, 2002. **NY**: 'Liberty'/M9, IFP vs. organic, 2006/07; G. Peck, unpublished; [b] no pruning, training, taxes, interest, etc.; cullage IFP 3-17%, organic 3-75%; [c] gross margin only. **Switzerland**: IFP 'Golden Delicious' vs. organic scab resistant variety, 2008; E. Bravin, ARBOKOST, ACW. No land charge or establishment cost included.

Table 2 Economic Comparison, courtesy of David Granatstein WSU USA

Currently organic producers in the USA achieve between 30 and 100% premium over conventional prices. I asked David Granatstein how Washington State producers would respond if the premium was to be removed due to over production or reduced demand in light of the current economic crisis. Would they remain committed to the organic process? His response was that currently their costs were similar, yields were similar and packouts (quality) better, why would they change the way they produce? At worst if there were no premium they might forgo the audit process costs and drop certification but maintain organic practices and records to enable them to re-certify at a later stage if economically justified.

He also commented that he felt the largest contributing factor regarding the pricing level for organic apples in Washington State is that demand for fresh sliced organic apples has been strong. This market offers higher prices, for lesser grades and smaller fruit, than they would otherwise receive and this establishes a floor price for fresh market organic apples. How the downturn in the economy effects demand for this relatively new convenience food is yet to be seen.

Australian Considerations

Australia has the following limitations as far as organic apple production is concerned:

Firstly it has a relatively small population. This limits the amount of organic production which is likely to be consumed locally and therefore the scope for producing for domestic consumption. Direct marketing or niche supply to specialty shops is an option for small producers based on locality and demand but large production needs to be focused on supermarket supply and export options.

Secondly our labour costs are among the highest in the world, so remaining price competitive with other international producers is difficult. All measures to reduce labour inputs need to be considered and planned for. Eg high density plantings requiring less pruning and less expensive to harvest.

Thirdly our soils are generally more depleted than other growing areas around the world so greater emphasis on improving the soil must be given if considering a change to organic.

Australia has the following advantages

Firstly Australia is counter seasonal to the two largest markets for organic fruit in the world being USA and Europe, and Australia already has a clean and green image overseas.

Secondly Australia is free from Fire Blight and Western Australia is currently also free from Apple Scab and Codling Moth. Maintaining strict biosecurity measures allows producers to make the transition to organic production without the added pressure these provide.

In the face of global changes to climate and economies, Australian farmers willingness to embrace different thinking and trial new ideas, as can be seen by the number of farmers taking a biological approach to production, will ensure that creative solutions continue to be found, by producers good at adapting to often less than favourable circumstances, with little direct government assistance.

Organic Apple Option in Western Australia

Cripps Pink (Pink Lady ™) is now the largest planted variety in Australia. Being a late season variety, there are many apple producing areas in the world where producers have difficulties getting to harvest without freezing their crop. Producing Cripps Pink organically in areas where apple scab or fire blight are a problem has been difficult and is not the preferred option, however Western Australia is not one of these areas. The market for conventional Cripps Pink is well established and so there is no need to educate consumers on a new organic variety. Cripps Pink is well suited to many value added options, particularly apple cider production.

A spur bearing sport of Cripps Pink, Pinkabelle ®, which was discovered in an orchard near Donnybrook Western Australia, is able to be planted on a vigorous rootstock and due to the dwarfing characteristics of the scion, the tree only grows to about two metres height. This tree lends itself to an intensive organic planting, with a strong root system able to access maximum nutrients, minimal support structure requirements and a compact tree, with all the labour savings associated. Conventionally grown Pinkabelle ® in its 6th leaf is capable of averaging 30kg per tree and up to 45kg on some trees. At a planting density of 3000 trees/hectare this puts potential yields at 90 tonnes/hectare. Apples produced are ready for harvest 10 to 14 days earlier than standard Cripps Pink and tend to be larger counts. Fruit can be marketed as Pink Lady ™. under existing overseas marketing programmes.

24 Terry Fogliani and Pinkabelle (R) in his orchard

At these yields and potential market value of an organic crop, netting becomes a realistic option. Damage from birds (mainly parrots and cockatoos) can have a devastating effect on apple crops in Western Australia and netting removes the need for other bird scaring alternatives. Climate appears to be more variable lately and netting protects crops from hail, sunburn from extreme heat, and can reduce water use also.

Conclusion

When I first decided to apply for a Nuffield scholarship I thought it might be an opportunity to visit many examples of 'biological organic' apple producers successfully producing nutrient dense fruit free from insect and disease issues, as is our aim as producers. I had no idea how many of these producers existed around the world and I soon learned that the vast majority of organic produced apples worldwide are produced by 'replacement organic' means.

I used my research opportunity to see the variety of ways that organic apple producers currently remain profitable while meeting the requirements of their markets. I found that the passionate innovators of the sector, often frowned upon for their non-conforming approach were key players in pushing the boundaries and challenging the thinking of both fellow producers and researchers alike.

"Great spirits have always encountered violent opposition from mediocre minds"

Albert Einstein (1879-1955)

Opportunities exist for Australian apple producers to grow organically utilising biological principles and market a nutrient dense healthy product to selected counter season markets in the Northern Hemisphere. The level of government and industry support in Australia for independently researched and trialled `biological' production methods needs to be addressed so the rest of the horticultural industry can benefit from the systems that leading 'biological' supply companies are providing and the results that some innovative Australian producers are achieving.

Glossary

Conventional farming

Conventional is the term I have used for what could better be referred to as chemical farming. Chemical farming has only really been around for about seventy years, where as people farmed organically for thousands of years before this. Hopefully one day people might look back on this chemical era and refer to it as a momentary lapse of reason or perhaps temporary (or extended) insanity. Anyway seeing as in the majority of western countries for at least the current and the last generation most farmers have farmed using manmade pesticides and petrochemical fertilizers, for the sake of simplicity I have referred to this as 'conventional'.

Replacement Organic

This is a term which I have used to describe how many organic producers tend to look for and rely on organic allowable inputs to take the place of the conventional insecticides, fungicides and sometimes herbicides. They may use compost and other organic nutrition products but their focus is still largely on how they will wage (an organic) war on the insects, disease, weeds etc that threaten their crops. They are still attempting to mask the symptoms created by unbalanced soils and poor soil biology.

Biological farming

Is an approach which uses a combination of organic and conventional agriculture. It is a measured process, focused on balancing soil nutrients and building a soil environment which enhances the level and beneficial function of soil microbiology. It allows for producers to supplement with small quantities of plant available nutrients throughout the season, as determined necessary through monitoring plant and soil health. The aim is for healthy plants, that produce complex sugars and complete proteins that are not attractive to insects or diseases and therefore do not require the use of pesticides. Biological farming acknowledges the connection between soil – crop – animal – human health, and the responsibility farmers have to produce "nutritious" food.

Biological Organic

As with the description of biological farming however all inputs are organic allowable. Again the focus is on the health of the soil and plant. "Replacement Organic" strategies may be

utilized in initial stages while building a working biological system providing these strategies are not counter productive, preventing the aims of biological farming from being achieved.

Balanced Soil

A balanced soil refers firstly to aiming for the most productive percentages and ratios between the major cations in a soil as identified by Professor William Albrecht. When these cations are in proper balance, ideal soil pH of 6.2 – 6.8 is the result. Secondly it refers to the balanced availability of anions and cations to meet the specific timing requirements of plant growth and fruiting functions. Thirdly it refers to the support and balance of microbial populations in the soil.

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Plain English Compendium Summary

Project Title:	Maximizing profitability when going Organic Maintaining yield and quality in certified organic apple orchards
Nuffield Australia Project No.:	
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Objectives	To investigate how apple producers around the world maintain their profitability when making the change to certified organic production, with a focus on maintaining yield and quality. I wanted to see to what extent a "biological" approach to organic fruit production was being used and how successful producers were in implementing these techniques. I also wanted to see what different management techniques and organic inputs were being used by producers in other countries.
Background	Our aim as apple producers is to produce highly nutritious fruit from healthy trees which require minimal intervention with plant rescue (insecticide or fungicide) products even the organic allowable ones. This is the aim of most "biological" producers. In taking the next step to organic certification I was keen to see how successful other organic producers had been in implementing this biological approach. As success is not always guaranteed working with a natural system, and profitability is a necessary component of sustainability, I was also interested in collecting information on innovative organic replacement tools which could fit with our programme and not prolong the transition process.
Research	My research involved visits and interviews with producers, consultants, marketers and researchers in USA, Holland, UK, Italy, and New Zealand. I also had the opportunity to visit China and Japan, to see apple producing areas and compare production techniques to gain a greater understanding of their production potential and future market options. During my travels I attended Asia Fruit Logistica in Hong Kong, BioFach in Tokyo Japan, BioFach in Boston USA and Interpoma in Bolzano Italy.
Outcomes	The majority of organic apple producers worldwide rely on organic plant protection 'replacements' to deal with pests and diseases. Relatively few organic apple producers focus on a biological approach. Traditional research into "biological" production methods is almost non existent but some consultants and producers are having good success and attracting keen interest from other producers. There appears to be a much larger investment in research into replacement focused organic apple production in the countries visited than what is currently occurring in Australia.
Implications	Opportunities exist for Australian apple producers to grow organically utilising biological principles and market a nutrient dense healthy product to selected counter season markets in the Northern Hemisphere. The level of government and industry support in Australia for independently researched and trialled `biological' production methods needs to be addressed so the rest of the horticultural industry can benefit from the systems that leading 'biological' supply companies are providing and the results that innovative Australian producers are achieving.
Publications	