

R E S O U R C E G U I D E

Organic Avocado



COMPILED BY Ewen Willis, James Crockery and Doug Brown
PROJECT MANAGER Gavin Kenny ILLUSTRATED BY Fred Robertson

SOIL & HEALTH ASSOCIATION • EARTHWISE CONSULTING LTD • BIO DYNAMIC ASSOCIATION

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Organic Avocado Resource Guide

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Organic Avocado Resource Guide

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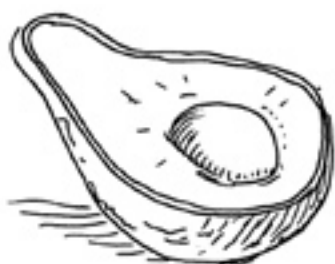


The Bio Dynamic Farming and
Gardening Assoc. in NZ Inc.
Founded on the work of Rudolf Steiner

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Preface

In the first half of 2001 a successful application to the Sustainable Farming Fund was made on behalf of the Bio Dynamic and Soil and Health Associations. The project aim was to draw on the knowledge and experience of established organic and biodynamic producers and make it more widely available. The first step was to identify key sectors where we felt the project would make a difference and involve experienced organic people associated with those sectors who were keen to contribute. As a result we focused the project on: dairy/pastoral farming; and avocado, citrus and summerfruit production. Successful organic producers are pioneers, as they acknowledge that there are always more questions than answers and thus are continually taking on new challenges. That capacity to take on new challenges has been very evident in this project. Individuals have taken on multiple challenges; they have acted as workshop facilitators, field day organisers and presenters, and have written and collated material for a series of Resource Guides. Many others have contributed through their participation at workshops and field days, by acting as reviewers and giving their time to make written contributions. This Resource Guide is a result of that work.

It is important to be clear as to what this Resource Guide isn't and what it is. It isn't a detailed technical 'how to' document, as there is no simple prescribed pathway towards successful organic production and there are still many more questions than answers. It is a number of things. First and foremost it is a multi-authored collation of existing knowledge, presented from a practical perspective. Second, there has been a deliberate weaving together of organic and biodynamic information. The purpose of weaving together a range of views is to provide you with choice – take what is relevant to you at any given time and ignore what you don't consider to be relevant. Third, it is intended to be a 'living resource'. We've drawn together what is known to help you avoid making the mistakes that others have and achieve success more quickly, and also to allow for clearer identification of gaps in knowledge so that these can be addressed. In summary, this document won't make you a good organic producer, it is not a technical 'how to' manual, it is intended to be a practical, living, Resource Guide. It is meant to guide, not to prescribe.

Gavin Kenny, Earthwise Consulting Ltd
Project Manager
August 2003

Avocado, Citrus, Pastoral and Summerfruit Resource Guides are available from the Project Manager (telephone 06 870 8466 or email gavinkenny@clear.net.nz) or in Adobe Acrobat (.pdf) format from www.organicnz.org and www.biodynamic.org.nz.

The Resource

This organic avocado growing resource compiles the experiences of numerous growers committed to managing land organically. Scientific research into the specifics of organic avocado management in New Zealand is very limited, so organic growers persevere with and develop traditional organic techniques: humus enhancement, compost making, mulching and biodiversity.

A growing number of land owners expressing a desire for biologically sustainable land management, coupled with publicised commercial demand for organics, has multiplied the number of people planting avocado trees and looking to organic orchard management.

This resource draws on the experience of organic avocado growers from Northland, Gisborne and the Bay of Plenty, consulted privately and at workshops convened for this purpose. Grower experience levels range from recent land owners commencing orcharding, through to established conventional growers converting to organics, to a few pioneer growers dedicated to the organic movement for decades.

Thus it is a collection of anecdotes, subjective trials, case studies and references, compiled as the foundation of a resource by growers for growers, that will be expanded, refined and corrected as organic farmers engage in their work – sometimes utilising information presented herein.

The pathway to success

There are two important ingredients to being a successful organic grower:

- 1) Access to information – this Resource Guide provides you with a start
- 2) Support from others. You can achieve this by:
 - Joining an organic discussion and support group can be a big help. This enables you to have support, especially through the transition period. Once you have some experience, this will in turn help support others in the group
 - If there is no discussion group in your area, try and get one going, even if it is only two or three people, and
 - If this is not possible, find yourself a mentor who you can phone and visit when you need to.

As part of this project there is an associated email discussion group for sharing information and experiences. To join the group send an email to Peter Urich (pbu@waikato.ac.nz) expressing interest in the group and you will be subscribed.



Introduction

Commercial avocado growing is an established fruit-growing sector. Current avocado growing information relevant to conventional and organic management can be obtained from the Avocado Growers Association manual with clear illustrated sections on:

- Climate and soil requirements (temperature range, rainfall, soil, site)
- Varieties and rootstocks (variety range)
- Propagation (rootstocks, hygiene practices, graftwood)
- Land preparation and planting (planting time, distances, individual shelters)
- Growth cycles
- Nutrition (essential macro and micro elements)
- Pollination and fruit set (flower structure, pollination factors)
- Irrigation
- Canopy management and orchard thinning (tree spacing, canopy management, tree thinning)
- Weed control
- Pests (description in pictures of main avocado pests)
- Root rot management (symptoms, environmental factors, control)
- Crop estimation
- Maturity (seasonal maturity guide by district, dry matter)
- Harvesting and crop handling (logistics, packing issues)
- The economics of avocado growing (the conventional parametres).

Copies may be obtained from:

NZ Avocado Industry Council Limited
PO Box 16004
Bethlehem
Tauranga
Tel: 07 571 6147 or 0800 286 223
Fax: 07 571 6145
Web: www.nzavocado.co.nz

Organic avocado growers have other imperatives to the efficient growing of a uniform crop on a given site (monoculture): avoiding synthetic pesticides and fertilisers; selective propagation; fostering a balanced species diversity of trees, sward plants, insects and soil microorganisms; compost making and a biological understanding of pests, diseases and weeds.

Thus organic growers come to understand that they are farming an ecosystem from which a crop is harvested. This understanding shifts the focus from management of factors that directly affect the avocado plant to fostering all the elements that support the avocado as the climax plant in the system.

Why organics?

Contributing organic growers will prevail with the adjective 'organic' to describe their agricultural activities.

The word is absorbing diverse shades of meaning, but the 'International Federation of Organic Agriculture Movements' (IFOAM) definition is generally accepted:

'Organic agriculture includes all agricultural systems that promote the environmentally, socially and economically sound production of food and fibres. These systems take local soil fertility as a key to successful production, by respecting the natural capacity of plants, animals and the environment.'

Organic agriculture dramatically reduces external inputs by refraining from the use of chemo-synthetic fertilisers, pesticides and pharmaceuticals. Instead it allows the powerful laws of nature to increase both agricultural yields and disease resistance.

Organic agriculture adheres to globally accepted principles, which are implemented within local socio-economic, geo-climatic and cultural settings. As a logical consequence, IFOAM stresses and supports the development of self-supporting systems on local and regional levels.'

Web: www.ifoam.org

Why are some orchardists practising organics?

Common motivators expressed in grower workshops (held in 2002) were:

'Chemical free food and environment for the family'

'Ethical agriculture and commerce'

'A GE free statement'

'Recognising a philosophical/spiritual dimension in farming'

'Increasing global consumer awareness and demand for eco and human friendly foods'.

Starting versus converting

When looking to the application of organic information, a primary difference was apparent between starting out with bare land and converting an established orchard. Growers planning new orchard development can plan and action: early adaptation of sward, mapping land contours and micro climates in relation to appropriate crops, gauging pest pockets and possible animal zones in the orchard system. A grower coming to organics with an established orchard is limited in choice. The converting orchardist is often adapting a monoculture, and assists the evolution of that system towards diversity from a problematic base of biocides and established pests and diseases.

Individual beliefs and conclusions about methods of organic tree crop growing cut across the generalisations like 'diversity and 'design'. Established organic avocado growers range from minimum intrusion or 'closed gate' systems (using only on-farm inputs, no machinery within the orchard, tolerance of avocado crop variability with secondary crops buffering low avocado fruit set years) to intensive management (purchasing proprietary organic inputs, employing monitoring consulting services to increase yields). A general overview expressed at grower workshops (held in 2002) was that genuine organic management became easier over time, requiring less intervention as the orchard's ecosystem became sustainable.

Biodynamics

Organic growers with biodynamic interests co-ordinate some orchard activities with astronomical observations, and routinely apply a range of herbal/animal/mineral preparations to their farms. Relevant biodynamic methods will be mentioned in sections of the Resource and further detailed information can be found from the Bio Dynamic Association (see Certification section for contact details).

Towards real sustainability

An influential writer and researcher on this subject is Dr Stuart Hill, whose ideas were summarised in an article in the NZ avocado journal (*Avoscene*: September 2002) by an organic grower Tony Daamen, writes:

In order to build a mental perspective on which can be measured the progression of organics it is worth paraphrasing a much-quoted model of Dr Stuart Hill's, a long-standing ecological and organic thinker, who has worked extensively with organic farmers around the world. Dr. Hill sees three stages in the transition from conventional to organic farming, these being efficiency, substitution and redesign.

Initially the conventional farmer for whatever reason thinks of changing his management practices to a less interventionist approach. This leads to an **efficiency** based approach where, for example, a calendar spraying programme is replaced by one based on insect monitoring or climatic fungal pressure data. The efficiency stage is by definition more about reducing costs and limiting damaging effects on the environment by reducing inputs, however it does not involve changing the chemistry of the inputs themselves. That next change occurs in the second, **substitution**, stage where the farmer chooses to replace conventional inputs with organically certified inputs such as a change from organophosphate to pyrethrum, or from glyphosate to thermal or mechanical weed control methods. The substitution stage coincides with the minimum entry level for most recognised organic certification standards, and due to a number of reasons some organic farmers do not progress beyond this level. If as an organic grower you are regularly having to rely on the use of inputs that are either restricted or prohibited in terms of certified organic production standards in order to correct otherwise uncontrollable pest, disease or nutrition issues, you will continue to yo-yo between efficiency and substitution, and so struggle to maintain organic status, until such time that the problem, or more likely problems, are addressed on a deeper level.

Progression to the final stage of **redesign** requires a paradigm shift in terms of the farmer's understanding of interactions within the farm environment and the wider effects of his or her farming activities on the functioning of that environment. The first step along the redesign pathway involves adopting a holistic approach to pest management. An example of this would be addressing an unacceptably high level of unmarketable fruit due to insect damage by implementing a combined approach including introduction of beneficial insect species, fostering insect preying bird species including feral cat and rat control, planting of understorey plants that help support the bird and beneficial insect populations, replacement of shelter or other plantings that host problem insects, limiting use of soluble nitrogen fertiliser inputs (e.g. raw manures, fish based products), judicious use of only pest-specific substances if population peaks do occur (i.e. falling back on a substitution 'safety net') and development of a marketing strategy that best focuses on the perceived quality advantages that organic production represents.

In reality, the step from substitution to redesign is one which most farmers find the most difficult to make as it requires either an in-depth understanding of the holistic functioning of the growing environment or the courage to take what amounts to being a giant leap of faith. Often the impetus required to take this step is generated in part by circumstances of turmoil within a produce sector such as occurred in the New Zealand pip-fruit industry in the 1990s. That industry's economic woes played a large part in catapulting its organic sector to the level of development it is at today. However it is only recently that they have in a sense 'hit the wall' again with ongoing problems managing black spot, and lower yields, and are only now beginning on the pathway of a redesign approach. Inevitably this is happening with a few pioneers who have managed to make the philosophical leap into what is largely unknown territory. To their advantage the standard of genuine organic research now being undertaken within the pip-fruit industry is part of a self-sustaining momentum that is both required and generated by an organic produce sector that has in effect attained critical mass.

While Dr Hill's model is based on the assumption that all organic farmers evolve from a conventional farming background, the reality is that the attraction towards organics brings individuals into the industry from a myriad of backgrounds and often with a mindset already attuned to the substitution, or even redesign, stage. In practical terms this presents a problem in that the research and therefore knowledge required to satisfy this often enthusiastic entrant to the organic sector sometimes falls far short of expectations.

My observations over the various workshops are that organic avocado growers are being hindered by just such a situation. Present research on finding a practical organic alternative to phosphonic acid treatments for combating *Phytophthora cinnamomi* is in most cases restricted to trials based on a substitution approach. The identification and potential importance of beneficial organisms within the soil/root and leaf/fruit surface environments goes largely unexplored despite the impact such organisms have on pathogenic agents in those areas. Research based on such organically acceptable concepts as pheromone disruption, biological soil management (including use of soil inoculants and beneficial insect introduction/amplification methods) benefit not only the growth of the organic sector but can also result in cost saving applications for the conventional grower. Adopting a slightly greener mindset has potential benefits for all of us and in time will help narrow the gap between the efficiency based AvoGreen regime and true organics, to the advantage of both.

Propagation

Ideally, the organic grower's plants are grown in a humus-based mix with seed and plant material from certified organic orchards. Currently, no organically certified nurseries supply this stock, though as demand increases some professional nurserymen are likely to grow such stock. At present, certifiers are allowing uncertified avocado stock to be planted subject to transition period rules, typically three years. Bio-Gro rules will require certified plant stock from the end of 2003.

Homegrown

Alternatively, it is feasible for organic growers to produce their own trees in a medium of screened certified compost, peat moss and coarse sand/pumice mix (one third of each). This well mixed material is put into PB10 avocado planter bags (settling 30mm from top) into which a medium to large rootstock seed is planted with the flat side down. Zutano seed is the preferred rootstock because it is vigorous, easy to graft and available at convenient times (July/August for the propagation sequence).

Zutano seed is winter planted and grown on for about six months to 7–10 millimetre diameter seedlings, a good size for grafting in January in a shade house. Performance of alternative rootstocks is occasionally explored. At least one Bay of Plenty mature commercial avocado planting is on Hass rootstocks and performs successfully. Zutano rootstock has become conventional but testing of alternatives more suited to organic systems has barely begun.

Minimising *Phytophthora* infestation

The most problematic disease in NZ avocado orchards is *Phytophthora cinnamomi* fungal infection of tree roots.

To minimise the spread of infection with nursery trees:

- Heat treat seed, 20 min in hot water 47°C to 49°C
- Sterilise propagation mixes
- Store propagation mixes with no contact with soil or water run off.

The above methods are physically feasible for the home grower. Well matured compost can be heated by the barrow load, shovel stirred in a half drum over heat. Should the grower want a biologically lively medium, well matured compost without a soil ingredient, made on a well drained site and mixed with peat and grit without soil contact (on plywood or weed mat) will minimise *Phytophthora* infestation.

Nursery

A small inexpensive shade house (e.g. 3 metres x 3 metres x 2 metres high, 50% shade) in a sunny position in the orchard yard is a good site for this work. The floor should be weed/grass free, covered with weed mat and covered with clean pumice or pebbles. Good organic husbandry includes the practices of basic seed selection and propagation techniques. Other beneficial nursery activities are stimulated once a simple facility is present (e.g. germinating or growing on native plants for landscaping and shelter variation; trays of annual flowers for spring orchard planting, bulking up divisions of perennial herbs for orchard planting (e.g. oregano, marjoram)).

Grafting

The avocado seedlings in the shade house are individually grafted (about 200mm above a soil level). Many general horticultural guides describe and illustrate basic grafting methods (e.g. cleft graft, whip, whip and tongue). Cleft grafting is easier for the beginner and suitable when stock and scion are the same diameter. Whip grafting is useful when stocks are thicker than scions.

Ref: *Gardens For Free – A Propagation Handbook for New Zealanders* by Geoff Bryant (Bateman 1992).

Scion wood

The optimum scion wood (which is the mature post spring tip wood from the north side of a healthy and consistently producing parent tree) is cut off approximately 100 millimetres down from the growing tip with all the leaves carefully nipped off with sharp secateurs (little 3 millimetre leaf stumps remain) and put into a sealable plastic bag that can be stored towards the bottom of a household fridge for up to three days if grafting is delayed.

Each scion is carefully cut to join the cut off rootstock (about

200 millimetres above soil level) using a very sharp blade (e.g. A Swan Morton scalpel No 21 secured in modelers handpiece) and the taped (e.g. 12 mm non-adhesive grafting tape) union is waterproofed with grafting grease or a natural water based paint. The beginner can carefully cut some elongated avocado wood from the lower side of mature trees and practise the cutting/grafting techniques beforehand with disposable wood of same age and size as the real job, it's not that hard.

After the scion wood has been grafted onto the severed root-stock, the success of the union is aided by a plastic bag secured over the scion wood and graft (e.g. 125mm snap lock bag). When the scion obviously begins to grow (buds breaking) after about a month, the bag should be removed (turned half inside out, dried in the sun, smoothed out and stored for next year).

Field propagation

One longstanding tree cropper working with difficult soils reported survival success with grafting seedlings grown from seed planted 'in situ', that is seed planted directly into the ground at a selected site with surrounding mulch and a stake marker. The resulting seedling is grafted as described. This 'no root disturbance' technique is easily trialled by orchardists exploring methods to reduce the impact of endemic root disease.

Growing on

Growing the newly grafted trees over ensuing late summer, autumn and winter requires common sense care; space the bags out, as a guide 100mm apart, allowing all round light and space for the tree. Maintain an even moisture level through the bag, don't over water: a tiny secateur tip puncture three quarters down will allow sight of too wet or dry medium. The comfortable tree and bag will weigh about 4.5kg. If obviously underweight or looking dry, two or three half litre waterings will seep down through the long bag. Diluted waterings (5%) from the organic seaweed or fish brew are beneficial for this casual nursery watering.

Planting out

If grafted in January the tree should be ready for planting out in October when the soil warms. The common fully enclosed individual tree field shelter ensures a good survival rate (growing environment and physical barrier to hares, tractors, children etc.). In a well sheltered secure site open planting of a staked tree is preferred by some growers.

Early preparation of planting sites is prudent, to set up soil and surface conditions that maximise root extension into the soil. The tree site sward can be skimmed off with a sharp spade (1–2 metres diameter), two buckets of well matured compost, light and friable from woody content, dumped on the site and a strong fork stepped into the plot and levered to fracture (not dug or turned) the tight top soil. A covering mulch of weathered wood chips, coarse leaf mould or similar, ensures a woodland soil environment. This enhanced fertility zone is created for the bagged tree, two to three months prior to digging the hole. Late spring planting, a generous hole is dug, a fork to loosen the sub soil; then combining the compost manually with the soil as the undisturbed root ball is firmed into the planting hole. An initial half bucket of water around the tree completes the planting out task.

An example of one grower's expansion of this method:

A system that we are trialling (trees are in the 2nd season):

1. Scrape a 2m diameter circle of turf from the planting spot as far ahead of planting time as possible. In our case it was about 8 months
2. Apply compost and mulch
3. Keep weed free by hand
4. Plant in holes big enough to accommodate the tree using about half a spade of compost mixed into the hole – enough to inoculate the immediate root zone with the right organisms, but not so much as to create a larger zone with different physical properties from the surrounding soil
5. Top up mulch and add more compost
6. In line with the row, 2 metres either side of the avocado planting spot, plant tagasaste. These would be better planted early winter before planting the avocados
7. Add frost protection as standard. In our case we had no wind protection or staking and whereas we lost about 12 out of 60 tagasaste during the weather bomb of June 2002 there was no damage at all to the avocado plantings
8. Continue removing any grass that grows within the mulched area. Allow herbaceous plants to self establish or better still plant companion species, woody herbs, comfrey or others that should feed the microorganisms compatible with avocado. In our case clover has established itself around most of the trees
9. After one year the tagasaste are big enough to be pruned back and prunings applied as mulch to the avocado. Continue doing this year by year until the avocado is being suppressed by the tagasaste, then remove the tagasaste entirely taking advantage of the mulch. If no chipper or mulcher is available it will still work simply by cutting the prunings small enough to lay them flat.

Orchard lay-out

Orthodox block plantings of Hass are spaced, 7 metres by 7 metres, applicable to organic plantings followed up with tree thinning to select the healthy producing specimens. The organic grower will modify the planting pattern to accommodate species variety and secondary crops. For example a suitable block, elevated, well drained and readily sheltered, may be centrally divided by 4 rows of mandarins or passionfruit, perhaps a banana planting in a natural drainage line (fruit and mulch source), forty avocado trees either side, predominantly Hass with closer spaced groups of Reeds and Zutanos. Perhaps an accessible corner, free for a yard of an organic beekeeper's hives. Think diversity; tidy spacing is secondary.

Intermediary crops visibly enliven the orchard with colour, insect and bird life. Marketing these crops engages the local community (gate sales etc.) another positive aspect of the organic diversity maxim.

Biodynamics

An organic grower interested in using a biodynamic approach to propagating work will use a bag mix compost that has had biodynamic compost preparations in it (six herbal portions inserted into a seasoning heap). Plant the seed during an ascending moon period (the moon path daily progressing towards the ecliptic) and probably plant the seed on the few days within ascending period when the moon is before a root/earth constellation. Grafting would also occur during an ascending period. Planting the trees is preferably done during a descending moon period, a timing favoured for work involving soil cultivating, compost spreading and transplanting.

These events are observable by the amateur astronomer, precise calendars are readily available.

The Bio Dynamic Farming and Gardening Association
PO Box 39045, Wellington

Ph: 04 589 5366

Web: www.biodynamic.org.nz

Orchard Fertility

Organic practice is rooted in the soil, a dynamic physical and biological medium. The level of biological activity is enhanced and deepened to the advantage of all interacting with it, including the orchardist and the cropping plants.

Soil

The key role soil has in an organic system can only be understood by understanding an overview of soil processes. A useful summary is provided in the companion *Organic Citrus Resource Guide*, with a more comprehensive summary in the *Organic Pastoral Resource Guide*.

Fertiliser

Fertilisers used on the organic orchard are amenable to soil microorganisms and by this interaction become available for plant nutrition. The fertiliser of greatest volume and weight on the organic orchard is well broken down compost made with as wide a variety of materials as practicable (e.g. animal manure, old hay, grass clippings, seaweed, chipped wood prunings, leaves etc). Also mineral fertilisers (specific ground rocks) are applied (e.g. dolomite, RPR, lime) and liquid fertilisers may be sprayed on and under trees.

Soil and leaf analysis

Regular autumn leaf and soil tests are useful to all growers. The organic approach does not meet annual empirical elemental requirement with calculable weights of specific compounds, but uses results as a guide to compose volumes and ingredient proportions when planning annual compost inputs and mineral spreading.

A practicing Bay of Plenty orchard consultant makes the following points about sampling on organic orchards.

Soil sampling:

When:

Mid autumn, simultaneous with the leaf sampling is best. Dry summer time sampling may return a false reading with an increased pH, potassium and sulphur level. After heavy rain events, wait for a week or so before taking the samples to allow the soil to drain and for the nutrient levels to stabilise.

Where:

In the sward: In organic orchards we value the legumes and other herbage in the grass sward between the trees. The soil should be sampled away from the trees every few years and the nutrients balanced to favour clover.

Under the trees: Orchards which were formerly using conventional fertiliser, often have highly elevated trace element levels under the drip-line. Therefore take the soil cores from about half way between the drip-line and the trunk. Scrape the mulch layer to one side and sample the soil only. Whilst doing this, make careful observations of the mulch quality, root health and soil biology.

Leaf analysis:

When:

Sampling should be according to local conditions and growth stage rather than following a calendar date. The sample should be taken as soon as the current season's leaves have matured and are no longer red or pale. For the Bay of Plenty this usually coincides with most of April.

Where:

The literature states 'the leaves should be taken at shoulder height and not from the boundary trees'. The problem is that on many mature orchards the leaves are either heavily shaded or they are well above shoulder height. Therefore it is suggested that for mature trees, 2 to 3m long handled pruners are used to harvest the leaves from the sides of the trees that are most actively contributing to the photosynthesis of the tree. Because there is a distinct nutrient gradient between the north and south sides of the trees, make it a policy to take leaves only from the east or west side of the trees.

Handling the results:

When the results of the leaf and soil analysis are returned, look at the relative ratios between the nutrients, which are known to be complementary or inhibitory to each other. When balancing the nutrients remember that excesses of nutrients are worse than deficiencies because once there is too much of an element in the soil, not much can be done about it afterwards. Avocados obtain the majority of their nutrients from the mulch layer, therefore high priority should be given to the quality of the mulch rather than just paying attention to the results from soil analysis. When applying lime, caution is required to avoid excesses, even if the soil test results indicate otherwise. As a suggestion make 2.5kg dolomite lime under mature trees an upper limit for a single application.

The graph presented with the results of leaf and soil tests is only there to give you an approximate appraisal of your current nutrient status and should not be used to formulate a fertiliser policy. The numerical data on the analysis results are the appropriate tool for making fertiliser recommendations. If the numbers or terms used on the analysis results were unfamiliar it would not be unusual because crop nutrition is a specialised science and you should seek the help of an accredited professional advisor.

Compost

(in addition to the general description above).

All organic growers agree with the truism 'you can't have too much compost!' It is practical for the orchardist with regular equipment to make 6–10 cuM per ha. A compost bay(s) near the orchard (not subject to bogging) alongside a hard track for easy dumping of ingredients is ideal. A mature (4–6 month) heap (or section of longer heap) of 10 metres long, 2.5m wide (at base) and tapering to 1m high, is required for 10 cuM unit. Smaller heaps in other corners work well, (same cross section size but short). Every heap generates a zone of extra fertility, insect and bird activity and is easily spread around proximate trees in short work periods.

Compost ingredients

Compost making becomes a continuous practice on the established organic property because convenient ingredients emerge all year round: grass clippings; autumn leaves, spoiled hay, broiler dung, and importantly twiggy material, wood chips, sawdust for the encouragement of beneficial fungi. Stockpiles can be contained within a few bales; big pieces of plastic (e.g. untreated timber covers) weighed over dry ingredients and



heaps. It's easy to dampen heaps but difficult to 'dry' water-logged (i.e. anaerobic) heaps. Heaps should be moist, not wet (water squeezes out) or dry (dusty).

Open heaps

Open heaps without structures work best, 3 or 4 metre long sections (to be extended) of coarse base 2.5m wide of light shelter trimmings (scrub barred bracken/gorse/blackberry) then layers of ingredients are added. Perhaps 150mm of bark, then a thickness of broiler dung followed by grass clippings, seaweed, a bucket of lime broadcast over the first half metre. Water hosed over dry ingredients or damp weather construction will suffice and so on. The essentials for the composting process to function are air, water, warmth and 'food'.

Compost heat

To make up 6–10 cuM of compost per ha requires a daunting volume of ingredients; so progressive construction of the elongated heap is convenient, constructing two or three cuM sections when a few heaps of ingredients are assembled. At least a 2–3 cuM section is a volume required to generate a good heat (65 degrees in the first few days, then gradually decreasing). The intense microbial activity expressed in the temperature is stipulated by certifiers to ensure the breakdown of contaminants present in some inputs (e.g. residue in non-organic chicken manure or meat/bone meal).

Turning

Small heaps, hand built, initially in layers, can be mixed with a strong handled fork as work progresses. The turning of the compost is timed by temperature observations. A typical sequence turns in cooler ends and sides of a heap during the initial hot week, thereafter turning to maintain aeration and to monitor moisture.

Many growers are using machinery to collect materials (catcher equipped mowers or silorators), turn heaps (front end loader, hired bobcat), or compost spreading trailers.

Animal manure

Some compost makers believe well made compost without animal manure is satisfactory. Others maintain manure is crucial for the optimum range of nutrients and organisms in the final product that is applied to a nutrient hungry tree type. Inclusion of manure, 25% by weight (e.g. dairy yard dung, poultry manure, piggery slurry) of compost ingredients is common. Again variety is desirable; if poultry manure is the greatest animal input, augment with a bag of meat/bone meal (per cu.m), fish scraps (fresh) or fish meal: as long as such inputs are documented (certificate of analysis and/or statement of origin) and hot composted they are allowable. As the organic industry expands the availability of inputs from nearby certified farming becomes more common and the inputs are obviously preferable (e.g. organic poultry operations, dairy farms). Costs are reduced by self-hauling or labour exchange. Stockpiles of dung must be covered to prevent rain leaching of nutrients.

The compost debate

The compost subject is one of lively debate, with various opinions about desirable ingredients, turning frequency, microbial content, commercial supply and quality. Consensual points emerge:

- The greater the variety of ingredients the better; woody content is essential
- An initial hot period of about 1 week when a completed heap approaches 70 degrees C to kill weed seeds and pathogens
- Further turning during weeks post hot phase is temperature gauged to maintain good aeration of the heap and a proving temperature as positive microorganisms multiply (approx. 20°C)
- An unturned maturation period (minimum 1 month before spreading) to enhance fungi development
- An understandable quality measure is required when purchasing ready made composts.

Minerals

Liberal quantities of calciferous mineral are spread in NZ avocado orchards. The organic grower has ready access to the certified products; lime, dolomite, gypsum, also phosphate rich reactive phosphate rock (RPR).

Some soil advisors suggest that the addition of these bulk minerals to compost heaps may increase their bioavailability and also the microbiological activity of the compost.

Subject to soil/leaf analysis overview, a typical mineral maintenance spreading programme is:

Early spring (September): 5kg certified lime under each mature tree (diam: 10m, proportionately less on smaller)

Mid spring (October): 5kg certified screened gypsum under each tree

Late October: 5kg RPR under each tree

Autumn (April): 5kg dolomite and May 5kg gypsum per tree.

The minerals in coarse powder form are typically hand spread from buckets, marked at 5kg intervals, working from under and outside the tree, covering the canopy ground area and out beyond the drip line as evenly as possible. Buckets are refilled from a bulk bag on a vehicle in the headland.

This modest example given is not a prescription but gives an idea of the logistics involved for dozens or hundreds of trees.

The grower is aiming to achieve a pH lower than neutral (6.4 – 6.8) with adequate calcium and phosphate levels.

Trace elements

Most organic avocado growers historically gauge and manage trace element levels in soil and trees. Those growers preferring a low input system will depend on a compost trace element supply, especially from marine ingredients, occasionally augmented with a conservative quantity of salts or oxide mixed with purpose-made compost. Microbial action makes the element more plant available and holds soluble element compounds in less soluble soil structures. Target levels quoted in conventional texts (e.g. *AGA Growers Manual*) are derived from records of high producing conventional orchards. Organic growers understand there are dozens of minerals active in the soil environment, with undetermined dynamic effects, so compost served trace element input is a safer approach.

Options for trace element introduction are:

- Direct application of trace compound after certifier permission (restricted input)
- Proprietary certified compost mixes with specific trace elements
- Foliar/soil fluids containing specific trace elements.

Liquid fertilisers

Numerous liquid fertiliser (fish and/or seaweed based) concentrates are on the market, some certified, and these are commonly used by the organic grower to introduce nitrogen and trace elements during the peak growth season: Sept, Oct, Nov and Dec. The *Calendar Management Guide* specifies some products and rates of application including recent development of certified boron/zinc foliar feeds on a restricted basis.

Home brews

Self made liquid fertiliser 'brews' may be diluted for use in the same manner and timing as the proprietary liquids. The nutritive qualities will be variable (probably weaker than proprietary concentrates) but considering the cost of proprietary concentrates, 2 or 3 ground/tree spraying with a home made liquid feed is a cost effective trace element and microbial energiser.

Fish

A fish concentrate can be made in 200 litre plastic drums (or larger plastic/stainless tanks). The drum is near filled with fish – clean skeletons/heads or chunks of large animals (sharks or stingrays) – and these solids covered

with water. A weighed plank 'lid' keeps out dogs. Leave to ferment for about six months and the mixture separates – to a grey scum on top and amber liquid for most of the volume and a few kgs of longer bone and scale on the bottom. The amber liquid is decanted and stored (recycled 20 litre clean plastic container) for use as the concentrate. Remaining residue is poured onto a compost heap and covered.

The concentrate is diluted 1:100 (1%) and sprayed over trees and ground later in the day once during Aug, Sep, Oct before flowering (higher dilution rate if air blast sprayer volumes required).

Some organic orchardists claim that the use of fish introduces a nitrate oversupply leading to unbalanced plant growth and insect numbers. This observation is probably dependent on the freshness of the brew and concentration used. With slow fermentation and 1% use the brew is a biological enhancer.

Seaweed

A seaweed liquid or tea can be made in 200 litre containers loosely filled with seaweed and covered over with clean water. Seaweed concentrates traces of elements from erosion carried to shorelines by rivers and currents. A wheelbarrow walk at low tide on an open beach after rough weather quickly yields sacks of weed for the brew containers. The many species of *Gigirina* (from which agars are extracted), like large and small kelps have mealy nutritious feel and smell, and may be roughly chopped with sharp spade or slasher and then put into drum and covered with water (a sack tied over the top keeps out mosquitoes). After two or three weeks and occasional stirring, a brown mineral liquid is easily decanted and bucketfuls strained into the foliar spray tank (10 to 15% dilution) with the fish and similarly diluted in the watering can for nursery bags and garden use. Top up the drum two or three times. Start again when the brew is obviously weakening.

Note: Avoid use of chlorinated municipal water.

Mulching

Much effort is expended on avocado orchards (conventional or organic) making, collecting and spreading mulch. The avocado tree has a raft of surface roots in the soil surface/mulch interface. The mulch is beneficial in promoting water conservation and increases soil fauna under the tree, and promotes natural saprophytic fungi that may have mycorrhizal-like benefits to avocado nutrient uptake, or could be involved in suppressing *Phytophthora* population by competition.

The organic grower seeks material permitted by certifiers (e.g. Bio-Gro approved pine bark, manuka residue from oil extraction (signed description by processor) and hay/straw from certified organic cropping or pasture properties.)

Options from the home orchard: wood chips from thinned/

pruned avocados and shelters, shredded prunings and light shelter trimmings of casuarina, wilted pine trimmings buck raked into headland heaps for the purpose, scrub bar harvested light gorse and bracken, dried fern fronds, sliced banana trunks and leaves.



Often fine and coarse mulch materials are available at the same time (e.g. wood chips and shelter trimmings from winter work), a good combination, with light material first covered with the coarse. Breakdown and disappearance of fine mulches is quickened by birds turning over mulch for worms. A coarse topping prevents this; the mulch lasts 3 times longer.

A cautionary note: some chipped material contains resins, phenols and other substances that the tree used to protect itself from fungal attack. These substances are inhibitory to fungal activity when applied to the soil. As a general rule any chip that has a strong smell, like pine, lawsoniana, cryptomeria or eucalyptus, should be aged before applying, at least until the smell has gone and preferably until you can see fungal growth in the pile. Pine bark peelings are the worst and should be thoroughly aged.

One cu.metre of mulch will cover the perimeter of a large tree from the drip line inward about 1m. If plenty of mulch is available, fill it in from the outside, walking on the mulch carpet (less root scuffing). As a minimum the perimeter circle tends to contain natural leaf fall and suppress the weediest zone.

The argument as to the type of mulch (with or without inoculants) that assists in suppression/diversion of fungus *Phytophthora cinnamoni* is yet to be decided by ongoing research.

Biological initiatives

International organic momentum has stimulated research and commercial energy into benign biological enhancements for agriculture. Systems promoted in New Zealand were often mentioned during discussions with growers.

- Soil Foodweb Inc. has presented workshops in New Zealand conducted by president Dr Elaine Ingham, promoting research based enhancement of humus with composts and compost teas which can be applied to the soil or sprayed on to the trees (see Section 10)

Further information on compost and compost tea making can be obtained from Soil Foodweb Institute Pty.Ltd. 1 Crawford Road, East Lismore, NSW, Australia 2480.

Web: www.soilfoodweb.com

Ref: *The Compost Tea Brewing Manual* 2nd edition Dr Elaine R. Ingham 2001

- Effective microorganisms (E.M.) purports to generate a specific group of naturally occurring beneficial microorganisms, from a base mixture grown in a simple home warming and molasses feeding system. The resulting liquid is diluted for foliar and soil application.

The aerobic organism mixture was discovered and developed (in 1982), by a Dr Higa of Okinawa. Variations for compost use and insect deterrence are included in the E.M. data.

A NZ web address www.kiwiorganics.co.nz

- Vermiculture products – worm farm processing of organic waste for castings and fluid residue are marketed by a number of companies as soil biology stimulants. Many proprietary products are marketed.

Ref: Worm products – New Zealand Organic Register, Sian Cass Ph. 06 354 0142

Web: www.org-register.com

The organic certification status of these, apparently benign applications to organic growing, are yet to be clarified.

Biodynamics

The organic avocado orchardist practising biodynamic methods will time pivotal fertility work with sun and moon rhythms.

For example:

- (1) The primary biodynamic cow horn manure preparation (prep 500) is stirred and lightly sprayed on sward and under trees spring and autumn during descending moon under an earth constellation. This preparation is the 'starter' of a conscious biodynamic influence on a property, strengthening the humus: the farmer's essential resource, delicate and dynamic. ('For many plants there is absolutely no hard and fast line between the life within the plant and the life of the surrounding soil in which it is living' – Rudolf Steiner.)
- (2) In supplement, a horn silica preparation (prep 501) is sprayed fine and high early in the day during rising summer, within an appropriate moon period.
- (3) Compost heaps that have matured with portions of the six compost preparations (502 – 507) deep within, are spread during a descending moon period.
- (4) Liquid fertiliser brews have a set of preps 502–507 stirred in and when mature, are diluted and sprayed preferably during the week prior to full moon when nutrient uptake is maximised.

These example timings are not dogmatic: personal and climatic diversions will occur, but the biodynamic farmer inevitably becomes observant of moon and star movement over the property and desires to plan the 'compulsory' organic tasks to a broad cosmic schedule.

Ref: Web: www.biodynamic.org.nz

Pests

Pest control in an organic avocado orchard is achieving balance in an ecosystem where a wide diversity of insects integrates lifecycles within the landscape. Conflicts may arise when the activities of a few could damage the trees and/or the crop. The insect's diversity of involvement ranges from the soil food web to pollination of trees in spring.

The two most damaging insects are the leafroller and thrips. Left uncontrolled to reach levels of heavy infestations they can seriously damage a commercially marketable crop.

Leafroller

Leafroller is by far the most dominant pest reject factor in export avocados (83.3%), followed by thrips (8.3%), mites (5%) and armoured scale (3.3%).

For leafroller, organic growers may use *Bacillus thuringiensis* or BT for short. BT is a bacterium specific to caterpillars that has no recorded detrimental effect on beneficial insects or bees. BT is ingested by the caterpillar and disrupts its digestive system. BT has better control during the younger stages of the leafroller worms cycle (i.e. 3–5 weeks), rather than the adult stage. Effective spray timing usually begins prior to flowering in October through to late March at fortnightly intervals, only if needed by the organic grower.

Thrips

Greenhouse thrips may cause severe damage to avocado fruit causing a silvery-brown discoloration. There are several generations each year and they are most active late summer through to winter. As of January 2001, HortResearch began the release of the new greenhouse thrips parasitoid – *Thripsobius semiluteus*, which is a vigorous feeder only on the larvae stage of thrips. *Thripsobius* looks to be having some control over thrips. HortResearch are currently monitoring the situation. www.hortresearch.co.nz: check media release 13/03/2001.

Greenhouse thrips can be controlled with broad spectrum organic sprays such as garlic, pyrethrum or neem oil. Certified organic growers must be aware that these two products are



restricted input sprays as deemed by the organic certifying bodies and should be used as a last resort in the organic system.

Note: Natural pyrethrum is a well known restricted insecticide in organic systems, but is an indiscriminate insecticide. With observation and timely use of limited spectrum agents (oil, BT, neem) the killing of beneficial insects inevitably accompanying the target populations can be moderated.

Mites

There are two species of mite; the two-spotted mite and the more common six-spotted mite. Heavy infestations of the six-spotted mite have been found in the Far North, with some isolated findings in the Bay of Plenty. There are no control measures registered for conventionally grown avocados.

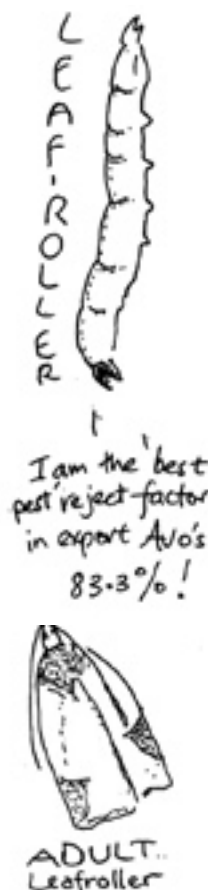


Four out of the seventeen research reports in the 2002 NZ Avocado Growers Association research report are concerned with control of six spotted mite (SSM). Three pesticide approaches and one predator evaluation demonstrate the resilience of SSM.

Organic growers do not have the tools to use against the pest directly. Soil biology, plant surface biology, tree health and the presence of indigenous SSM predators that can multiply with mite infestation are variables the organic grower works with. One established certified grower reports a 1998 spring SSM infestation with defoliation affecting 20% of the orchard. A Mount Albert Research Station entomologist visiting the area came to the orchard, identified established populations of predatory mites and ladybirds, and correctly predicted the expansion of predator numbers to limit further defoliation. New leaf growth proceeded without SSM damage.

Armoured scale

Collective term for *Latania* scale and *greedy* scale. Described as armoured because the adult stage is seen as an immobile cap on the fruit surface, miniature and limpet-like (2mm), often around the stem of the avocado fruit. Mature females produce a crawler stage



that disperses to settle, secrete the permanent cap and expand the visible population scattered on the fruit.

These 'mother' scale can become heavily present and cause quarantine problems for export avocados. Scale has 2–3 generations per season and all stages are present in the orchard. Warmer climates like the Far North can develop heavy infestations.

Armoured scale can be controlled easily with ultra-fine oil applied in early spring before flowering, with one initial spray cover and another follow-up spray application if deemed necessary after a monitor check. This oil application is also a restricted input for certified growers.

Monitoring

Methodical insect number monitoring in avocado orchards is an established procedure. The Avocado Industry Council in conjunction with Fruitfed has a programme available at a cost. Growers themselves can undergo training as scouts with the AIC. The advantage of a trained scout doing the monitoring is that a grower receives information that has been collected in a standardised manner that is comparable to other orchards.

This training is co-ordinated by the Avocado Industry Council (Tel: 07 571 6147). Avocado growers can learn to recognise pest levels found in the orchard, what types of insects are present, their size and numbers and most importantly to monitor for beneficial insects.

Orchardists learn to test for different thresholds, where to look for pest insects and to understand different monitoring procedures. An organic grower's primary benefit from monitoring is to have an accurate threshold for spraying.

Predators

In an organic orchard, the best control of problem insects (such as leafroller and thrips) is the natural presence of predator insects (such as the ladybirds, lacewings, hoverfly, yellow-banded wasp and the recently introduced tiny wasp parasitoid *Thripsodius semiluteus*). These beneficial insects require a diverse range of habitat therefore the more variety of host plants provided by the orchardist, the greater the chance for build-up of beneficial insect numbers. A good example is how wildflower species can produce great quantities of pollen and nectar, which is valuable food source for beneficial insects.

Wildflower mixes can be designed to flower over a long period of the growing season. Swards of wildflowers can be sown into

Im no lady
when it comes
to being a
predator!



strips 1.5 to 2 metres wide into open sunny areas and a suggested ratio is 400 square metres of wildflower beds for every 10,000 square metres of orchard area. If a more mature avocado orchard is in full canopy, the beds can be sown out on the side lands or headlands wherever possible.

Wildflower World Limited, PO Box 8161 Tauranga. Email: info@wildflower.co.nz

It takes time to develop a diverse orchard environment: ground plants and crop mixture supporting beneficial insect life cycle and moderating the expansion of damaging insect population that will in turn significantly threaten crop returns. If leafroller caterpillar populations are routinely killed with BT (*Bacillus thuringiensis*) control, useful populations of the predatory hover fly (*Melanostroma fasciatum*) and the bullet wasp (*Goniozus jacintai*) are unlikely to become an integral part of the orchard ecosystem. Similarly routine oil sprays for scale will affect egg rafts and pupae of other insects, not forgetting impact on soil biology. Balances do work if the naturally occurring populations of spiders, flies, mites, ladybirds and wasps (etc) are fostered over a time span of years. The general idea of spraying a biocide must be qualified with the above in mind.

Pest pockets

Pockets of infestations can be identified early and confined without broad spectrum agents. Heavy bearing trees can be fruit thinned (primarily the smaller/misshaped fruit) to limit leafroller favoured clusters, where worrying infestations are observed. The north face of a heavily laden tree can be hand gun sprayed with BT. Similarly, the early detection and limiting approach can work with thrips and scale when infestations spread from sheltered corners or from ignored and neglected amenity trees (such as that old orange tree that has become a 'scale nursery').

If a biocide is judged necessary, spot spray the most problematic corners of the orchard or parts of the trees; a light oil for scale, neem oil for thrips, BT for leafroller, but a localised application for minimal disruption of the expanding and diverse orchard ecosystem that is surely developing if the orchardist is thoughtfully working towards balance.

In summary, the more diverse the habitat developed by the organic avocado orchardist (varied sheltered species, mixed sward, crop variety, apiary site) the better the chance to naturally moderate the activity of avocado damaging insects.



Diseases

Fruit rots

The two major fruit diseases in avocados are Anthracnose and Stem end Rot, which are dispersed fungal diseases. These fruit damaging fungi like undisturbed conditions and prevail in the trees on dead leaves, branches and mummified fruit, so good orchard hygiene helps to alleviate these diseases.

The spores of up to five fungi affect immature fruit in the orchard but are not manifest as fruit rots until fruit begins to ripen. Spores are dispersed by water (vapour or rain) and by air movement.

Conventional growers use up to twelve applications of copper each year for control, but certified organic growers are allowed 3kg per hectare (equivalent to one application per hectare per year), because of concern over toxicity to insects and soil organisms. Historically it has been shown that exported organic avocados after 28 days sea voyage had similar disease levels compared to conventionally produced avocados.

An organic avocado grower will minimise fruit rot spore spread by maintaining air flow and light through the orchard, cutting out elevated spore sources: mummified fruit and dead branch build up inside trees. Personal involvement in harvesting work as picker or bin service and loading will oversee handling of the crop and help minimise physical damage and subsequent rots.

Avocado root rot

(*Phytophthora cinnamomi*)

Phytophthora cinnamomi, more commonly known as avocado root rot is a soil fungus which attacks the soft, white feeder roots of the avocado tree. Root rot is widespread in many avocado producing areas around the world. It is a water mould which thrives in wet soil. Water is required for spore production but individual spores have a mechanism to survive for long periods of dry conditions. The fungus is commonly introduced into the orchard in diseased nursery trees. It can also be spread in soil attached to boots, tools and vehicles.

Early symptoms show a gradual decline in growth, causing poor fruit size and loss of yield. Leaves reduce in size, are pale green to yellow and wilted, falling readily. Eventually the tree is reduced to a bare framework of dying branches. Death of the tree may take from a few months to several years. Declining trees sometimes set large crops of small fruit.

Disease management

Root rot is the most difficult disease to control in an organic management system. Tree injection with phosphonic acid (e.g. Foli-R- Foss. Tree Doc.) produces dramatic recovery of trees even from an advanced stage of root rot. The use of phosphonic acid treatment for curing *Phytophthora* is a contentious issue among organic avocado growers. There are some growers who believe it should not be used in an organic management system because of residue issues, possible resistance and having to inject the trees using syringes doesn't rest well with some growers. However controlling *Phytophthora cinnamomi* for organic growers is the most urgent focus of research and, until a suitable method has been developed for organic growers, some may pursue the option of using phosphonic acid.

Bio-Gro standard

BioGro have set the following standard based on trial work carried out on an organic orchard during 97/98. Residue test results showed levels of 1.3 and 4.3ppm after 24 months which were under the maximum level set by BioGro of 10ppm.

The use of phosphonic acid as a treatment for curing *Phytophthora* is a restricted practice under Bio-Gro production standards with a 24 month stand-down period on all injected trees. A maximum level of 10ppm (10% of the NZ MRL) of phosphonic acid, residue in avocados from trees which have been treated with phosphonic acid, qualify for Bio-Gro certification.

Any reduction of this time would be dependent on treatment data rates and residue test results at different periods following the treatment. All trees that have been treated with phosphonic acid must be segregated and clearly marked. Parallel production protocols must be applied when harvesting fruit from these trees, meaning that fruit from treated trees will be picked and packed separately and marketed as non-organic. The Bio-Gro inspector must be notified prior to harvest as he may well want to be present during this time.

The current Demeter standard: phosphonic acid as an injected phytophthora control is disallowed.

The current AgriQuality standard also does not allow the injection treatment with phosphonic acid.

Biological controls

There seems to be no doubt that high levels of organic matter around the roots is an effective way to control root rot. Ideally roots should be growing in a compost/mulch layer on the surface of the soil. If the mulch is kept moist roots will migrate close to the soil/mulch interface. Activity of *Phytophthora* is reduced in the compost/mulch layer and at the interface of this layer with the soil. Some kinds of worms (e.g. anecic earthworm – *Pheretima hawayana*) are good at incorporating compost into the soil and by so doing take the disease suppressing effect down to and around the roots. Basically, while the mulch is on the surface and the roots remain in the soil, the *Phytophthora* fungus remains unaffected. So bring the roots up to the mulch and take the mulch down to the roots.

The avocado tree originates from the rainforests of South America, its root system is typical of a 'leaf litter feeder' in that it is shallow and multi-branched therefore tends to prefer a fungal dominated food web. The more complex the soil food web the greater the biodiversity, which provides numerous organisms that can compete with disease-causing organisms.

To re-create a rainforest environment by building up the soil organic content and maintaining a layer of mulch around the trees extending 0.5 m beyond the drip line, establishes conditions that favour avocado root growth and inhibits the development of root rot fungus. Various mulch combinations are being scientifically trialled.

The New Zealand Organic Avocado Grower Group (NZOAGG) recently signed off a research proposal for an AGMARDT progressive farming grant. The proposal is to determine the efficacy and methodology for using natural compounds for the control of *Phytophthora* root rot of avocado trees.

In summary – organic control of avocado root rot can be worked towards by:

- Selecting a site with adequate free draining soil
- Planting disease-free nursery trees
- Maintaining mulch layer around trees
- Planting fungal dominated cover crops (lavender, rosemary, thyme and marjoram)
- Achieving good levels of soil calcium by applying calciferous rock dusts
- Maintaining soil pH in the range 5.5 to 6.9
- Maintaining adequate levels of soil moisture, abundant mulch good
- Adequate nitrogen: this element has the greatest effect on tree performance. Applied as compost and liquid fish fertilisers
- Applying high fungal compost tea
- Introducing leaf litter from native bush which has a large range of beneficial fungi. Spread around the drip line with other mulch.

Care of the root zone

The root zone is the whole orchard surface area when the trees are mature; the orchardist must be aware of compaction by not driving close to the trees with lugged tires (hand mower/ride-on near trees). Use headlands for transport around the orchard, not tractor/truck shortcuts through – compost and minerals on a vehicle positioned in headlands and conveyed to trees by light equipment. Don't have big lumps of branches under trees that block Hydralada wheels that then grind through the mulch and into the root zone. These common sense measures are particularly important for the organic avocado grower without recourse to routine phosphonic acid infections.

A possible 'recycling' option

A long term approach to managing avocado root rot in one established organic orchard involves the 'recycling' of trees: half pruning or stumping infected mature trees that will sprout healthy growth, simultaneously planting (nearby) young compost grown stock from robust plant material (seeds/scions) selected from the same site.

Given generous organic treatments (rich compost, replenished mulch, thinned of most fruit) some trees will gradually recover; if not, the next step is a 'half-prune' when the top half of the tree structure is felled (Hydralada & chainsaw sections). A badly infected tree (nearly de-foliated) should be felled to a 1–2m stump. Such heavily pruned trees will usually coppice, i.e. grow back with many healthy shoots that can be pruned/selected for the basis of a new tree structure. The newly felled tree should have sun exposed stumps whitewashed to prevent sunburn. The re-grown structure will flower and fruit after about four years.

Young trees propagated from apparently resilient material can be planted nearby (4–5 metres) to allow thinning options 4 years after the pruning work.

A prerequisite for the above system is having a supply of robust compost grown trees, using material from existing trees tolerating endemic *Phytophthora cinnamomi*.

Biodynamics

The organic orchardist with a biodynamic approach will consider the pest/disease issue from a farm organism stance. A range of

The Crop

property enterprises provide natural inputs and a varied income so the vagaries of weather, market, pest and diseases are moderated.

The use of biodynamic field and compost preparations (500–507) are believed to strengthen the 'farm organism' and thereby resilience of individual crops. Preparations are routinely applied over the property by spraying and compost spreading.

The Horn silica preparation (501) is sprayed by growers of fungus vulnerable crops at specific lunar and planetary events associated with fluid movement and potential fungal expansion.

The preparation can be used pre-flowering (Sept, Oct) over avocado trees.

The use of 'peppers' has been developed by biodynamic practitioners over many decades, whereby small quantities of seeds, skins or insects are collected and burned at specific times and the resulting ash diluted homeopathically and sprayed back into the environment of a threatening pest population. The aim of all this is to interrupt the reproduction cycle of the pest insects thus limiting the reproduction of damaging insects. The efficacy of the method seems to be specific to site and timing; it can be a powerful tool used as a last resort because the effect can be eradication rather than contributing to the ideal of a self-balancing ecological system.

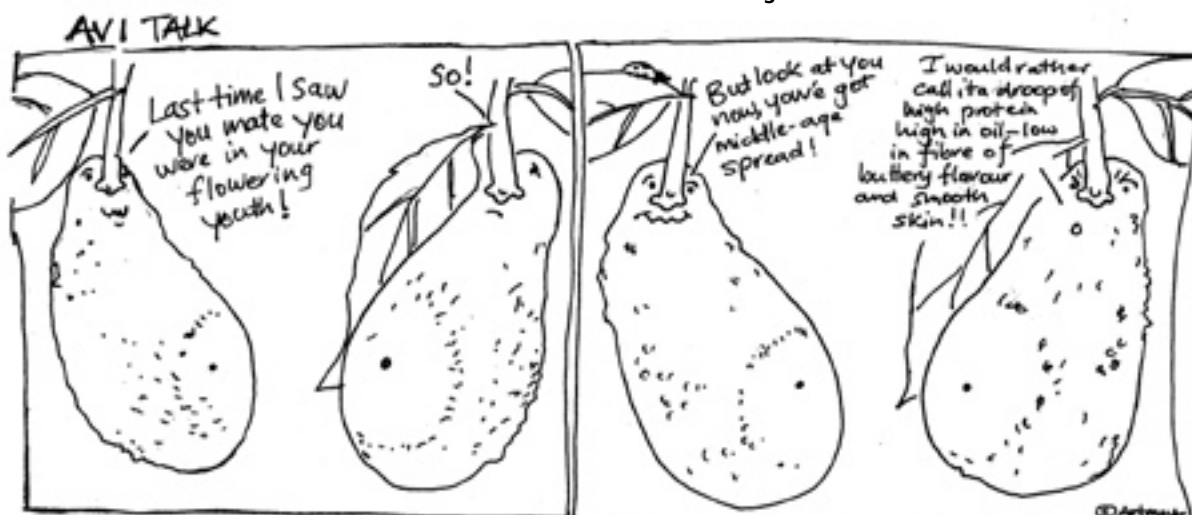
The organic grower has two options for his main crop (Hass): export and domestic market, with export usually the better option for financial gain. Harvesting follows the conventional routine of an early summer select pick of larger fruit (200+ grams) with a second strip pick after December, timing dependent on rainfall and the sizing of the fruit left on the trees after the early pick. Processors of avocado oil have certified their plants and low grade (tag 3) fruit is off the eatable fruit market. This has helped to strengthen the local market returns and has created a new product within the avocado industry enabling all growers to sell all of their avocados.

Harvest

The utmost care must be taken during picking, handling and transport of organic avocados to ensure there is no possibility of contamination or misidentification of the fruit. In accordance with all organic standards, any piece of equipment to come in contact with the fruit should be washed or replaced prior to the harvesting or grading organic fruit. Failsafe systems of fruit identification must also be adopted to prevent any confusion between (or mixing of) conventional, transition, Bio-Gro, Demeter and AgriQuality. Transport to the pack house must be by separate vehicle for conventional and organic fruit.

Off-orchard practices

Unless you are packing your own avocados, effectively your organic certification procedures end at your gate. Therefore it is important that the packing facility you have employed to pack your fruit has protocols in place that meet certification standards and the pack house is formally contracted to meet the standards of the grower's certifier.

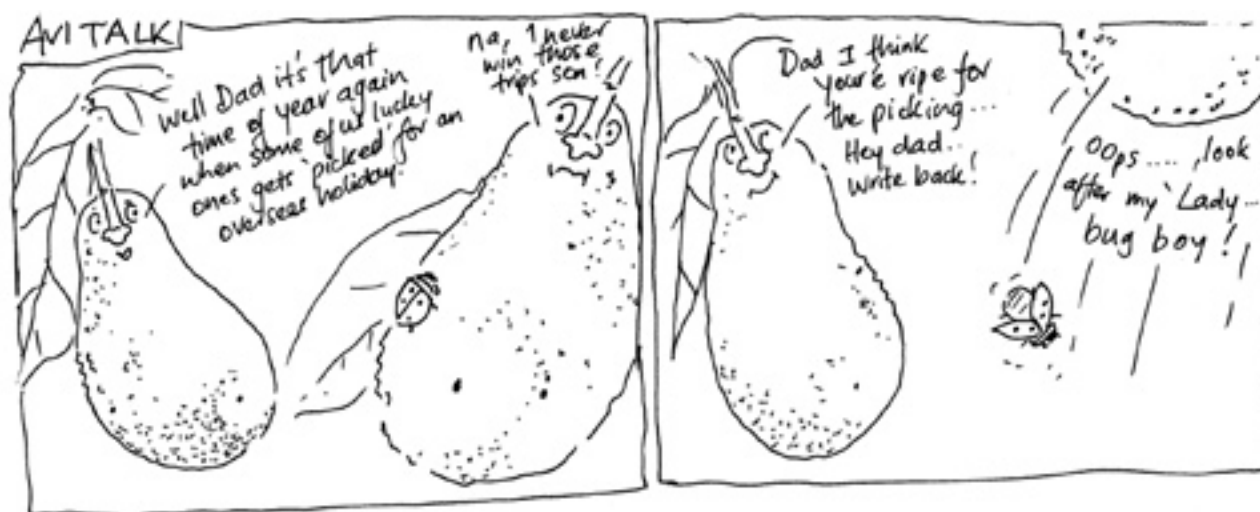


Post-harvest treatments

Organic avocados cannot be treated with Sportac for control of fungal rots. During the 1993/1994 avocado export season, an organic grower's trial use of natural pyrethrum to address export phytosanitary standards became a standard practice. Dipping has been replaced by inline fruit spraying to overcome fungal spore concentrations in dipping tanks.

Inline water blasting of avocados before grading has been implemented in at least two export packhouses, but it is not an industry-wide practice. The theory of water blasting as a prepacking process is to help clean the fruit and rid them of unwanted possible pests (i.e. scale, leafroller, egg raft and fungal spores). This method appears to achieve export phytosanitary requirements.

An autumn harvest (April) of Hass of inner-tree residual fruit is usually profitable for domestic markets and this time of the year is also a good time to condition the emerging new crop. Hydraladas have completed routine export harvest picks and are available for dry hire during the autumn (wash down before towing onto the certified orchard). It is revealing for a grower to get amongst the canopy for traces of insect variety identification and density, and also growth sites of the trees can be uniquely inspected and obvious misshapen and small fruitlets can be removed at the same time the mature fruit is being picked. Familiarity with Hydralada use (starting on flat areas with smaller trees) affords new insight for the grower into the canopy part of the orchard and gives the grower an awareness of the expensive contract harvest procedures.



Domestic market

The certified organic avocado grower often grows for the domestic and export markets. Early and later picks are graded for export sale, domestic sale and oil processing. Export fruit are graded, stored, transported and sold by a grower's export agent. The avocado oil fruit is purchased by a processor and fruit graded for the domestic market is handled by a trader specialising in that field or collected by the grower for independent marketing.

If growing exclusively for the domestic market the orchardist can consider certification with OrganicFarmNZ, a strictly local market scheme aimed to keep fees for certification lower. The local market distributors and consumers are frequently requesting certified avocados, so this new small grower scheme aims to protect the consumer and fortify the integrity of the local organic grower.

Overview

Although there is a local market grade standard, it is not as stringent as it is for the export market. The demand for domestic sales is very strong with an average of approximately 2 tonne of certified organic avocados coming into the market on a weekly basis. With New Zealand currently approaching 100 tonne per annum of certified avocados to consume, the export market obviously becomes an important factor for financial survival. Domestic fruit quality does not have to be as blemish free as export grade. A consumer buying an organic avocado does not mind a minor blemish on the skin surface as long as the fruit is appealing. Overall, packaging and freight costs are lower to get to the domestic market, however returns per fruit unit can be less than half of the net return compared to export fruit.

Export market

The export of certified organic avocado is still in its infant stage with three sizable co-ordinated seasons behind us. The first organic avocados were exported from New Zealand to Australia in 1980, which was three years before Bio-Gro NZ was formed.

Today there is a strong demand from both Australia and the USA. To meet export standards the organic grower needs to be vigilant when maintaining a monitoring programme for managing pest and disease control. The grade standards for non-organic and organic avocados are the same. Packhouse results from the past two seasons indicate that the labour cost to pack an export tray of organic avocados is higher than non-organic fruit. This is because of higher reject rates caused mainly by leafroller damage. The difference is reflected in the number of export trays per bin: 38 for organics against 50 trays on average for non-organic fruit.

All export of organic avocados to date has been Hass. Reed and Fuerte have been discussed as other possible exportable avocados but none have been exported at this point in time. The secondary varieties can be locally marketed before and after the established Hass season. The Hass harvest in NZ fits nicely into niche markets in Australia and the USA when their crops are not so readily available.

With intelligent overseas marketing experience and contacts, NZ organic avocados will always find a market as long as consistent quality can be maintained.

Production data

	Organic	Non-organic
Average size	24.4	23
Trays per bin	38	50 avg
Tonnes per ha	00/01 5.75	96/97 3.65
	01/02 7.10	97/98 5.22
		98/99 6.35
		99/00 7.18
		00/01 8.86

(AvoScene Oct 2001)

Financial viability comparison?

The above raw data echoes the question of a number of growers genuinely interested in commencing in an organic avocado enterprise or thinking of converting a conventional orchard, i.e. a comparative financial

evaluation of conventional avocado growing and organic avocado growing.

A definitive answer is not available because no one has devoted the extensive time to quantify and analyse all variables, significantly:

- Returns per tray favour organic product
- Gross yields per ha. are generally less on organic properties; great variations exist
- Environmental costs of both production systems have not been quantified for comparison (e.g. water and air pollution, energy expenses, human health, wider ecosystem sustainability etc.)
- Organic growers often integrate other crops and economic pursuits into their lifestyle. Organic avocado growers (singly or variously) grow kiwifruit, citrus, bananas, tamarillos, passionfruit, livestock, nursery stock, and at times have part-time professional, trade and/or artistic activities.

Avocado oil

Avocado oil produced in New Zealand is a premium, extra virgin, cold-pressed oil extracted from avocados, that makes a superb food dressing or cooking oil, and which is also an extremely healthy product. It is smooth and rich and does not disguise the flavour of food.

Avocado oil has a very high smoke point by comparison to other cooking oils, even olive oil. It will not burn or smoke until it reaches 255 deg C.

There are two companies in New Zealand at present processing organic avocado oil. Fruit processed is graded essentially sound but unsuitable for the fresh export or domestic markets.

The demand for organic avocado oil is strong and supply cannot meet this demand hence the price is up to \$1/kg for this grade of fruit, later in the season.

Avocado oil processing contacts

Olivado

Olivado New Zealand Ltd
Retail Shop & Processing Plant
Sandys's Rd, Waipapa
RD 2 Kerikeri 0470
Bay Of Islands
Tel: 09 407 3080 Fax: 09 407 3082
Web: www.olivado.co.nz
Email sales@olivado.com

The Grove

The Grove Avocado Oil NZ Ltd
PO Box 16067
Tauranga
Bay of Plenty
Tel: 07 552 6364 Fax: 07 552 6385
Web: www.avocado-oil.co.nz
Email oil@avocado-nz.com

Certification Information

Organic growers may wish to have their properties certified. Certifying organisations codify the rules for managing an organic property (e.g. input audits, on farm inspection and report, wider environmental impacts, compost quality and diversity levels). Certifiers charge for these services.

Copies of organic production standards are available from certifying organisations which outline the above procedures, practices and materials.

In New Zealand there are three bodies that register organic growers: the Bio Dynamic Farming & Gardening Association that own the Demeter trademark, the NZ Biological Producers and Consumers Council Inc. that owns the BioGro Trademark, trading as BioGro New Zealand, and thirdly, AgriQuality trading as Certenz (please note that the trading name Certenz is going to be phased out and Agriquality will be used in future). All three are members of the International Federation of Organic Agricultural Movements (IFOAM), which is the governing international body. BioGro and AgriQuality are also accredited by IFOAM, Demeter NZ by Demeter International.

The three certifying bodies lay down a strict set of standards relating to management strategies and farm inputs that must be adhered to if certification of a property under a particular trademark is to occur. The farmer/grower contractually agrees each year to abide by the certifier's written standards. These regulations are based on such factors as the environmental impact caused by the manufacture or use of many herbicides, insecticides and fungicides, the effect on soil fertility by synthetic fertilisers and the fostering of ecosystem diversity on various levels within the farming environment. The organisations charge for inspection services and administration of the standards.

Demeter trademark



The Demeter certification trademark denotes agricultural products produced using the biodynamic agricultural techniques detailed by Rudolf Steiner in a course of lectures given in 1924 to a group of landowners in Germany. The methods have been amplified by practitioners around the globe since that time (including NZ in the late 1920s). The Demeter trademark first appeared in Germany in 1928. Biodynamic farmers look towards the living processes that comprise the farm – soil, water, plants, animals, humans, air and wider influences, such as sun, moon and planets.

Bio-Gro New Zealand



Bio-Gro New Zealand was founded in 1984, as an independent, non-profit Incorporated society, to promote the interest of organic production in New Zealand. Activities include the setting of organic production standards; inspection and verification of Bio-Gro licenses and License Applicants; research and education. Bio-Gro New Zealand is funded entirely by membership and inspection fees, licensing levies, donations and grants.

AgriQuality



AgriQuality New Zealand organic standards are based on internationally recognised standards, which were developed to allow market access to the USA, EU, Australia, Southeast Asia, UK and Japan. The standards introduction quotes 'this standard has been prepared for the purpose of providing minimum requirements to be complied with to gain certification for the production of, and the labeling and claims for, organically produced foods.'

Organic FarmNZ



In 2002 a small growers' certification scheme was launched, which is administered by the Soil and Health Association based on Bio-Gro standards. Small regional groups of growers (pods) meet for mutual inspections. An independent auditor oversees. Strictly for domestic marketing.

Far North Organic Growers & Producers Assn

This group was founded in 1989 by a group of growers, home gardeners and customers who were interested in organic methods of growing fruit and vegetables. A certification scheme was worked out, standards established and the scheme was running by 1991. Far North Organic Growers & Producers (FNOG) Association has since become a certifying body under OrganicFarmNZ. However the original FNOG certification still operates independently for growers marketing locally where this established logo is recognised. Strictly for domestic marketing.

Information and certification sources

Bio-Gro

P O Box 9693
Marion Square
Wellington
Tel: 04 8019741
Fax: 04 801 9742
Email: info@bio-gro.co.nz
Web: www.bio-gro.co.nz

Bio Dynamic Farming and Gardening Association in NZ Inc.

P O Box 39 045
Wellington Mail Centre
Tel: 04 589 5366
Fax: 04 589 5365
Email: info@biodynamic.org.nz
Web: www.biodynamic.org.nz

AgriQuality Ltd

Certenz –
David Brown
PO Box 307
Pukekohe
Tel: 09 237 1807
Fax: 09 238 3757
Web: www.agriquality.co.nz

OrganicFarmNZ (small growers domestic certification scheme)

Soil and Health Association of NZ Inc
PO Box 36-170
Northcote
Auckland 9
Tel: 09 419 4536
Fax: 09 419 4556
Email: info@organicnz.pl.net
Web: www.organicnz.org

Far North Organic Growers & producers Association

PO Box 157, Kaitaia
Web: www.farnorthorganics.org.nz

Converting to organic production

Growers changing from a conventional to organic growing system are required to follow a number of prescribed steps before being granted full Demeter, BioGro or AgriQuality Certification. The steps to follow and permitted practices are outlined in the Demeter, BioGro or AgriQuality production standards. During registration years well-documented management plans outlining production and management systems are required.

Year 1

While the reason for converting from a conventional to an organic management system can be for philosophical and/or financial reasons the decision to do so shouldn't be taken lightly. Real commitment is needed in changing not only management methods but also the mindset of a production system in terms of understanding environmental relationships within your orchard. The standards set by the certifying bodies are mostly declaration of intent, general direction to explore and pitfalls to be avoided rather than specific directions.

During the first registration year the crop has no organic status. Fruit from the first registration year can be sold as conventional product, but production methods must meet Bio-Gro, Demeter or AgriQuality standards during the registration period. No chemical pesticides, herbicides or soluble fertilisers can be used.

Years 2 and 3

Continuing to apply organic practices, an application is made each year to Bio-Gro, Demeter or AgriQuality for inspection to ensure the grower meets the requirements of the relevant standards. Avocados produced in conversion years can be exported as fruit from a property in conversion to Bio-Gro, Demeter or AgriQuality certified production.

Full organic certification

After 36 months application can be made for a licence for full organic certification. Organic orchards are inspected annually for certification.

Calendar

Here follows a monthly sequence of grower activities that have been made available from the NZ Organic Avocado Growers Group and are well received as a time-framed summary of the range of culture and input.

Management Calendar



June

Begin spreading Compost

Nutrition: Apply solid fertiliser and compost to create soil mineral balance. Rates will depend on soil and leaf analysis

Pest Control: Monitor for insect populations. Low activity at this time of the year

Biodynamic: Composts spread during descending moon period.



July

Nutrition: Apply soil nitrogen e.g. Sealords fish @ 30lts/ha, 6% N=1.8kg/ha
Sieber or Vitec @ 100lts/ha, 2.2%N=2.2kg/ha
Liquid Bio fish @ 5000lts/ha, 1%N=50kg/ha

Pest Control: Monitor for insect populations. Low activity.



August

Nutrition: Apply foliar nitrogen e.g. Sealords @ 2.5lts/ha, dilute @ 100:1
Sieber or Vitec @ 100lts/ha, dilute @ 100:1
Envir-fert N mix @ 10lts/ha, dilute @ 20:1

Pest Control: Monitor for insect populations. Low activity

Biodynamic: Foliars applied in week preceding full moon.



September

Nutrition: Apply foliar feed plus micronutrients @ 5–10lts/ha

Pest Control: Monitor for insect populations. Activity increasing

Mulch: Air and soil temperatures should be rising and now is a good month to apply mulch. The soil should still have good moisture content. Try to avoid mulching on top of very dry soil. It should be at least 15cm deep to encourage good root growth

Biodynamic: Application of preparation 500 during a descending moon period.



October

General: Start of flowering and will continue through to late Nov

Nutrition: Apply foliar feed plus micronutrients

Apply foliar boron (e.g. Envir-fert Ulex-Bor @ 5lts/ha)

Side dress with solid fertiliser mix. 1-5kg per tree depending on tree size as per June application.

Pest Control: Monitor for insect populations. Activity increasing

Biodynamic: Application of silica preparation 501 during morning in an ascending moon period.



November

General: Flowering is in full swing, should now be noticing how fruit set is progressing. Officially this month is the start of harvest for Hass avocados and continues through to January/February

Nutrition: Apply foliar as for October

Pest Control: Monitor for insect populations, lots of leafroller activity. Continue with BT programme.

As a total programme the calendar represents a concentrated high input approach, variations of which are worked out by individual growers (e.g. substituting homemade liquids for the proprietary products or a spray schedule limited to spot spraying dense pest pockets).

Other growers may thin and tolerate moderate pest intrusion in deference to predator expansion.

Some basic biodynamic practices are included at appropriate times.

December

- General:** Root flushing will be finishing around this time. If harvesting be careful not to damage the new roots. A mulch top up now will reduce any damage
- Nutrition:** Apply foliar feed plus micronutrients. Apply foliar boron
- Pest Control:** Monitor for insect populations, lots of leafroller activity. Continue with BT programme.

January

- General:** Harvesting
- Nutrition:** Apply foliar feed plus micronutrients.
Side dress with base fertiliser mix 1–5kg per tree
Irrigate if top 7cm is dry, moisten to a depth of 45cm
- Pest Control:** Monitor for insect populations, lots of leafroller activity. Continue with BT programme.

February

- Nutrition:** Apply foliar feed plus micronutrients
- Pest Control:** Monitor for insect populations. Leafroller numbers will still be high. Thrips now starting to appear and number will peak through to March/April.

March

- General:** Early fruit sizing and vegetative growth is slowing down as the tree moves into its dormancy phase. The summer leaf flush should be finished by mid April. There are not too many inputs as the tree goes into a dormancy period of at least 4 months.
- Nutrition:** Nil
- Pest Control:** Monitor for insect populations/leafroller and thrips.

April

- General:** Summer flush growth activity has ceased and is now a good time to take a soil test and plant tissue analysis
- Nutrition:** Nil
- Pest Control:** Monitor for insect populations/leafroller and thrips.

May

- Nutrition:** Apply foliar seaweed @ 5 caused 10lts/ha
- Pest Control:** Monitor for insect populations/leafroller and thrips
- Biodynamic:** Autumn application of preparation 500, moon timing as in September.

Note: As there are a number of companies offering 'Organic products', growers should be very careful about what products they bring onto their orchards. Using inputs that don't meet Bio-Gro, Demeter or AgriQuality specifications can lead to loss of certification. Before buying any product ensure that it is Bio-Gro, Demeter or AgriQuality certified or approved.



Minimise Contamination

From neighbours

Run off

- Contact the council and neighbours
- Have no spraying signs – identify property as ‘certified organic’
- Offer to maintain the areas contamination comes from (e.g. roadside).

Spray drift

- Contact your regional council:
 - They may declare you a sensitive area
 - They will advise you on procedures
- Write and send letters to neighbours, contractors.
- Maintain shelter belts
- Keep positive communications with neighbours.

Seed contamination

- Ensure you are not purchasing GM or coated seed
- Try to get organic seed
- Do your homework before buying and look at your options
- Don't pick up seed without a letter from the supplier stating it is clean!

Contractors

The only contamination is from equipment. Point out to the contractor their equipment must be cleaned before entering your property. It is up to you to check. You may need a letter stating this for certification.

General Resources

Certified Packhouses for Export of Organic Avocados
Bridge Cool Corporation Ltd
Main Rd, PO Box 86, Katikati
Tel: 07 549 3061
Fax: 07 549 3703
Peter Amon – petera@bccl.co.nz

Apata Centrepac Ltd
Turntable Rd, Apata, Tauranga
Tel: 07 552 0911
Fax: 07 552 0666
Marilyn Hayward – marilyn@acl-apata.co.nz

Sources of seaweed and fish fertilisers

There are many sources of products – listed below are a few suppliers.
You will need to receive confirmation of certification from these suppliers.

Ocean Organics
4 Fraser St, Paeroa
Tel: 07 862 8424 Freephone; 0800 732 9333
Fax: 07 862 8404
Email jill@oceanorganics.co.nz
Web: www.oceanorganics.co.nz

Garuda
PO Box 385, Te Puke, Bay of Plenty
Tel/Fax: 07 573 5859
Email: garuda@xtra.co.nz
Web: www.get.to/garuda

Organic 100 Ltd
122 Lochhead Rd, RD6, Tauranga
Free phone 0800 843 539
Email organic100@clear.net.nz

Betta Crop Organics
PO Box 9024, Hamilton
Tel: 07 824 4881

Naturally New Zealand Seaweeds Ltd
PO Box 38234, Howick
1/14 Greenmount Drive, East Tamaki, Auckland
Tel/Fax: 09 274 7733

Sustain-Ability
PO Box 64, Motueka
Tel/Fax: Andreas Welte 03 527 8095
Email awelte@clear.net.nz

(SM6 organic concentrated seaweed extract)

Further reading

- Balfour, E. (1975). *The living soil and the Haughley experiment*. New York: Universe Books.
- Fukuoka, M. (1978). *The one-straw revolution: an introduction to natural farming*. Emmaus: Rodale Press.
- Henderson, G. (2001) Ed. *Biodynamic perspectives* Random House.
- Howard, A. (1943). *An agricultural testament*. Oxford: University Press.
- Ingham, E. (2001). *The compost tea brewing manual*. NZ Bio Dynamic Association. *Biodynamics : New directions for Farming and Gardening in New Zealand*. Random House.
- Proctor, P. and Cole G. (1997). *Grasp the Nettle: Making biodynamic farming and gardening work*. Random House.
- Steiner, R. (1974). *Agriculture*. London: Biodynamic Agricultural Association

Suppliers of books on organic and biodynamics:

www.ceresbooks.co.nz
www.touchwoodbooks.co.nz
www.organic.net.nz

Web sites of interest:

www.attra.ncat.org National Sustainable Agricultural Information Service

www.sare.org The Sustainable Agriculture Network

www.rodaleinstitute.org The Rodale Institute

www.organic-research.com Organic Research.com

www.permaculture.org.au The Permaculture Research Institute

www.org-register.com The New Zealand Organic Register

www.soilfoodweb.com Soil Foodweb Institute

www.sustainablestudies.org

www.organicpathways.co.nz Organics directory, market place

www.organicnewzealand.org

Seeds

Biodynamic Seed Bank, Hohepa Homes
c/- Chris Hull, RD2 Poraiti, Napier

Mt Tiger Gardens
RD1, Onerahi, Whangarei
Web: www.mtttiger.co.nz

Kings Seeds (NZ) Ltd.
PO Box 283, Katikati
Tel: 07 549 3409
Fax: 07 549 3408
Email: kings.seeds@xtra.co.nz

Koanga Gardens
RD2, Maungaturoto, Northland
Tel: 09 431 2145
Fax: 09 431 2745
Web: www.koanga.org.nz

A Northland case study

This article appeared in The July/Aug 2000 issue of ORGANIC NZ
Journal of the Soil & Health Association

AVOCADOS – PEARS FROM PARADISE

One of the most delicious and nutrient rich foods available, avocados still have an air of mystique and luxury but they're not that hard to grow. Tim Vallings tells us how to grow the best avos, sustainably!

I've been asked how we grow our avocados and why I think they are the best. We don't use any pesticides, insecticides or fungicides – including those that are allowed under BIO-GRO or Demeter labels – and we believe our produce is better for human health than anything presently available, and production is more long term sustainable. We call our system 'Natural farming'. Top quality food can be produced commercially with a totally different, sensible sustainable system. Many of the popular horticultural practices are extraneous, impact negatively on the environment, and don't help produce a better crop. We have high yields and really large quality fruit, which are a meal in themselves.

Here's how:

Mulching

We have found avocados to grow on the ground more than in it. An avocado is a plant that thrives on a really good layer of mulch. To grow avocados well, the carbon content of the soil needs to be built up. This fact is at last widely recognised in avo circles and it is gratifying to see shelterbelts being mulched (instead of going up in smoke!). But if mulching involves chipping and transporting it is extremely energy intensive and certainly not sustainable if everyone did it. You also run the risk of bringing in weeds, as well as unwanted fungi, and compacting the soil still further. The biodynamic compost making is great but on an orchard scale ends up problematic because of the high energy consumption and time spent transporting it around the farm. It is also unsustainable when materials are sourced from another system. It is possible to grow

all the mulch you need right where you need it, just like in a forest. We cultivate various mulch plants in alternate rows next to the avocados and mulch them down periodically – whole logs, branches – and all take no time to rot down in the active top soil. Chipping does not happen in nature and is not required (simple hand tools like machetes make branches easier to handle). Our orchard tends to look 'a shambles' to people used to the more conventional systems – native herbs and shrubs sprout in every corner, weeds and wild vegetables rampant in places. This healthy natural chaos of biodiversity has less insect pests and more predator insects (Dr Phillipa Stevens, DSIR), than our chemical neighbours. We don't seem to need to inject our trees as most people do to try to prevent them keeling over with the dreaded *Phytophthora*. Injecting is a time-consuming job, popular virtually from the birth of the avocado industry locally, and all over the world these days. Avos are a risky crop, they can all drop dead on you if you don't understand them well and supply their needs. One avo tree can have more than 3000 fruit on it if all its needs are met. It is not about how many trees you have, but how many fruiting canopy hectares.



Air and soil

Plants grow in air not soil, they grow in the air gap between soil particles. Air is critical in soils. Soils with adequate fertility can show up symptoms of nutrient deficiency in plants if the air-filled porosity is too low. Fertiliser can solve the deficiency problem because the few living surface roots take it up, but this does not solve the real problem. Air is often incorporated into soils manually by cultivating, but this must occur before planting and not after, otherwise sensitive avocado roots will be damaged. To maintain air-filled porosity is difficult with a perennial crop. It is necessary to avoid heavy vibrating machinery in the orchard (like tractors) as much as

possible, especially when the soil is wet. With our 'row mulching' system we tractor only one side of the plants for the whole life of the tree – we never tractor in the mulch rows. We mow one side of the plants when they are young, to establish them among groundcovers and 'weeds'. The mown row enables us to be able to walk around and inspect what's going on, rectifying problems like hare damage or whatever. Later on, it enables us to move our ladders around and pick our crop efficiently. We pile our mulch (which is often in head-high piles) around one side of the trees. We cultivate groundcovers that we consider useful or beneficial in some way and easy to mow. A variety of plants living and dying provide plenty of fodder for an ever-increasing species of beneficial soil biota. Deep roots of quick-growing plants that are the pioneers of the orchard rot just as quickly as they grow, and provide deep worm ways, waterways and airways. It's not practical to add worms to do the job, it's necessary first to condition the soil so that worms will thrive and multiply.

Biocontrols

I think it absolutely wrong to introduce yet more foreign predator insects (like this new wasp for thrips control). It is a biological cure but the Royal Forest and Bird Protection Society and Department of Conservation opposed its introduction because of unknown long-term effects. We should better understand the predators we have in NZ already. The scientists are surprised that there is no thrips 'problem' in our orchard. They should work out why that is before introducing a new potential problem. Haven't we learned anything? It is similar arrogance that has led to the environmental problems caused by genetic engineering. Various beneficial micro-fungi are appearing on the market and could be a better idea to solve harmful pathogen problems, rather than copper or other fungicides. Copper is used widely and considered a 'soft option' spray and is permitted for organically certified orchards. Copper does work and is useful but use of copper sprays can cause it to accumulate in soils to levels as high as those found in areas where copper is mined. In fact, these levels have already been found in older plantations where copper has been overused. In a study of organic farms compared to conventional ones (on the exact same soil types), AgResearch scientist Dr Nick Waipara found that more species of beneficial fungi were present and in higher numbers than on conventional farms. We believe the answer is in stopping all fungicide use, providing conditions to suit and introducing local species of fungi which seem to have the ability to reduce disease (perhaps occupying the niches that pathogenic species would otherwise occupy). We have found dried commercial preparations to be largely inactive, which is possibly just as well because we could be mucking it up for ourselves by trying too hard to introduce foreign species when the local strains seem better suited to NZ. I believe a surprising number of unrelated species are in a joint venture with each other for mutual benefit: one of the most widespread of these associations is mycorrhiza – a partnership between fungi and roots. In return for a sugar supply, fungal hyphae transport minerals to the roots from far and wide (in some

situations certain species of plants have no need to grow many roots at all). In nature mycorrhiza are widespread, they are the rule rather than the exception – understanding and encouraging them is critical. It is my observation that copper and other fungicides are detrimental to these beneficial associations. Time-honoured methods can easily be 40 years or more of doing the wrong thing. For example, if CFCs had gone into mass production 50 years sooner, we would have lost the protection of the ozone layer surrounding the earth before we even knew we had it.

We don't ever irrigate our trees, believing it to be an unnecessary expense, as well as counter productive. Avocados have a tendency to get too big, so why water them only to have to cut them back? The harder you prune them, the bigger and faster they grow, and topping them can have the opposite effect to the one you want. The only way to handle the trees is to give them plenty of room – you could easily plan on an ultimate spacing of nine per hectare on most types of plush avocado dirt. Plant too close and you will have to ruthlessly thin to allow light to get right to the skirt of the avo trees. If this does not happen, the avos will form a canopy way up high with the fruit being reached with the greatest of difficulty. Well-spaced trees are the answer. They crop heavily and bring the tops down with thousands of heavy fruit – you can reach heaps from the ground without even using a ladder or longarm.

Pests and predators

Leafroller can be a real problem and is in most avocado orchards around here. Bt (*Bacillus thuringiensis*), a naturally occurring bacteria, is widely used by Organic and conventional growers alike. There are very few biocides of any origin that are really specific and, contrary to popular belief, Bt kills a certain number of beneficial creatures along with target ones. We need to proceed with caution when interfering in the complicated web of interdependence in a community of species. It is so complex that we cannot predict the long-term result of blindly spraying. A clearer look at the problem is required – observation without knowing anything or expecting anything, like a child, helps me to understand what I need to do. A balancing of the food chain needs to occur. Birds are the insects' natural predator so boosting bird numbers is important, but this in itself can be difficult. Unseen predators are at the heart of this problem – rats, mice, cats, ferrets, stoats, weasels and possums. Adjusting this balance to put us back on top along with the birds is the go here. Time normally spent on spraying should be put into pest control and nurturing native fauna. We have devised many cunning and cheap ways to kill these pests, which involves trapping and shooting mainly. We don't use poison much – because of its persistence in the environment and secondary kill – and have been rewarded now with so many birds and beneficial insects. Our methods are simple and they work. Rats are simply trapped using Fenn traps and need not be a problem. The same with all the other invasive ferals. We believe it would be worthwhile to fence our orchard completely from these predators, so we can further encourage other more beneficial indigenous fauna. We have begun assembling materials for an 'everything proof' fence

around our entire farm (donations welcome to assist with this project). We plan to use our orchard and farm property not only to grow food sustainably, but to provide a safe habitat for local endangered flora and fauna. We need areas that will act as reservoirs for recolonising other areas where the native biodiversity has been destroyed by feral pests.

The willy-nilly application of fertilisers can lead to problems, like the cadmium build up common here in New Zealand. It is so common that lots of our export crops have to be eaten here because they fail stringent export testing (we have no such testing requirements in New Zealand). There is a wealth of information to say that cadmium in phosphate fertiliser - including Organic brews - has built up in our soils, herbage and produce to alarmingly high levels. The signs have been showing up strong and clear in fish - they literally breathe the water running off our farms. This badly impacts upon the fish closest to estuaries, especially affecting shellfish like mussels and oysters (read MP Sue Kedgley's *Eating Safely in a Toxic World* for more details). We believe in applying only what has become deficient in the soil, and we discover what is deficient through careful observation of the foliage, testing and our increasing knowledge of this particular site. Then we apply what's needed in the purest form possible. Our growing methods gradually improve the conditions for our avocados and we think that in time we may be able to equal, or even exceed, the yields of the best orchards in the country as well as providing a sanctuary for precious harried unique indigenous species. We now can sit typing out articles like this on our computer with kukupa (native pigeons) only inches away, pigging out on the kawakawa berries on the other side of the office window! A few years ago, it was all grass and thistles. Avocados are multipurpose perennial trees that live for years - they not only nourish us from the inside out, but make the best face packs, hair and skin conditioners and (not only in California but Tai Tokerau/Northland as well) are the best for naked 'Twister' or sliding around on rubber sheets!

***'Our life is frittered away, by detail
- simplify, simplify'***

Henry David Thoreau

Tim Vallings

Tim and Zelka Vallings farm a 35-acre property in Maungakarama, growing avocados and other subtropical fruit as well as being co-partners in Forest Floor native tree nursery.

