



Quandong

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West Australian Nut & Tree Crop Association (Inc)
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Quandong • Third Quarter 2004 • Vol 30 No 3

DON'T MISS THE NEXT WANATCA GENERAL MEETING:**7.30 pm, THURSDAY August 19, 2004.**

At our next meeting there will be a presentation on:

The Kennett Tree-Planting System

At this meeting we are fortunate in having **David Kennett** giving a description of his controversial and unusual system for tree planting.

When David first outlined his ideas some years back, they were met with widespread scepticism, almost derision. But subsequent work by David on his Dowerin property have shown that his methods have had dramatic success there.

Come along to the meeting and see the evidence for the success of his methods, and perhaps work out whether they would also work for you.

This meeting is at Kings Park Headquarters as usual, but on this occasion is on a **Thursday** (instead of the usual Tuesday). See the attached flier and the article on page 3.

Late enquiries to 9250 1888 please.

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About the Cover

The cover drawing of the Andean Walnut, *Juglans neotropica*, is from the famous BOSTID book *Lost Crops of the Incas*. An article on this nut (a WANATCA introduction to Australia) appears on page 10.

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[Countryman / 2004 May 6]

Kennett sure nature's way is best

Companion planting of trees, not monoculture planting, is the way to success when it comes to fighting salinity.

This is the wholehearted belief of Dowerin farmer David Kennett who has planted 150,000 trees on his 170-hectare property since September 2001.

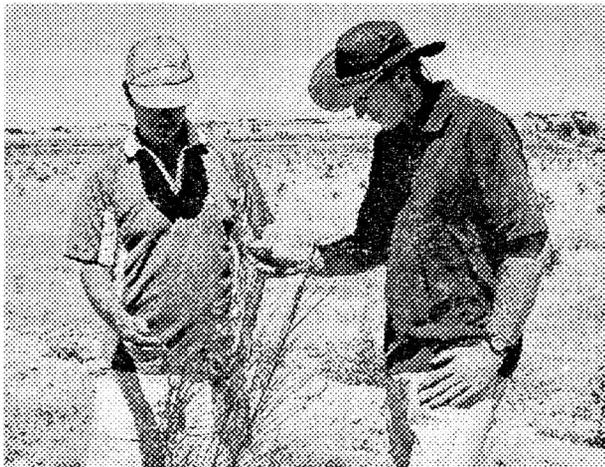
David has called the enterprise the Auria Research Project, after observing that a small percentage of trees in a plantation performed better than the rest.

"Nature never has monocultures and I suspect the reason for this is that plants have highly developed societies, in which every plant contributes for the benefit of its fellow participants," David said.

So far his diversified plantings have enjoyed a remarkable strike rate, considering rainfall of only 100 mm in 2002 and 288 mm last year (the average for the area is 330 mm).

He believes the key to this success has been companion planting and that once his theories have been proved, landowners will follow suit when they realise the benefits.

"I am convinced people will fall over



David Kennett and CALM revegetation project officer Dan Huxtable inspect one of the swish bushes growing on David's Dowerin farm. The swish bush is one of 20 species that has been under assessment for MDF (medium density fibre) for the possible production of paper and particle board.

themselves in the rush to plant tree crops if they use my methods," he said.

"For millions of years, a wide diversity of trees grew very successfully in the wild, but instead of copying nature's methods, we have consistently planted monocultures. And instead of growing trees that have evolved to suit the local environment, we have tried to

Quandong Links to ATCROS

Many of the articles, advertisements, and news items in Quandong refer to organizations and people who are listed in the Directory section of the ATCROS Web Site, which is at:

<http://www.AOI.com.au/atcros>

In this issue, items underlined in the text have Atcros reference numbers listed at the end of an article or elsewhere close by. This is so that readers can get more contact details.

ATCROS usually lists name, address, and phone numbers, also fax, e-mail, and web page details where available.

Quandong: Atcros ref. <A1466>.

plant trees that are adapted for other regions of the planet. Be they pine or blue gum plantations, apple orchards or olive groves, it has been necessary to provide them with a barrage of chemical nutrients and insecticides, all of which bring about additional environmental problems.

"Nature never has monocultures and I suspect the reason for this is that plants have highly-developed societies in which every plant contributes for the benefit of its fellow participants. Every living organism consumes and eliminates and I suggest that what is eliminated by one plant species, or variety, is nutrient for another."

So David has planted a wide diversity of trees and shrubs, all of which will enhance the performance of each other.

The method is to plant trees in straight rows in 20 m wide belts, 400 m apart (so normal farming can be undertaken) on the average contour (on typical undulating land) where they will intercept and harvest surface water.

In this way, only 5 per cent of the landscape is occupied by the trees and there will be no impediment to growing traditional crops between the tree belts. "The trees will also provide shelter for stock, and crops grown between the belts will yield better," David said.

"Not only that, correct planning of the belts will eliminate any surface water flow, soil erosion and salinity from elevated water tables".

"The tree crops will provide additional sources of income at different intervals, spreading risk and cash flow".

The trees will need protection from stock for several years, so there is the cost of fencing, but with the same number of trees growing in wider belts it will be less expensive than trees planted in numerous and narrow belts.

Already David has planted melaleucas, oil mallees and acacias and this year will plant sandalwood trees. He also wants to plant herbs like rosemary, in fact, all herbs that have Mediterranean origins.

Of the eucalypts, *E. plenissima* (which occurs naturally on David's property) has commercial value for eucalyptus oil, while the melaleuca *M. spicate* has crop potential for tea-tree oil and brushwood fencing.

"It will be easy to harvest the melaleucas and oil mallees at different times, which is good for cash flow, and they will recover quickly, thanks to the protection provided by their neighbours," David said.

"Once landowners begin to experience the benefits, it's my strong belief they will be encouraged to plant more trees.

"Hopefully, forward-thinking farmers will introduce them on their properties and we will be on our way to raising rural incomes and resolving our numerous environmental problems."

— Sally Hincks

Auria is on the Old Koorda Road, just out of Dowerin. David can be contacted on 9448 0473, 0427 600 024 or auria@bigpond.com.

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Predatory mites really work

Last Summer in Perth, quite a lot of people complained of mite attacks on azaleas, camellias, and other plants, me included. This time, I did something about it, without insecticide sprays.

Quite a few different sorts of plant were affected to various degrees. One of my worst victims were some *Lavatera arborea*, an uncommon plant here which serves as a fodder shrub on some Mediterranean islands.

The mites cause the leaves of plants to be covered with brown, yellow, or beige spots, sometimes coalescing (see photo at bottom). They are said to be Spider Mites and Two-Spotted Mites, though they are so tiny that I couldn't even see them, let alone count their spots.

So I ordered some predatory mites from Eco-Echidna, the people who talked to WANATCA last year about plant raising using organic methods.

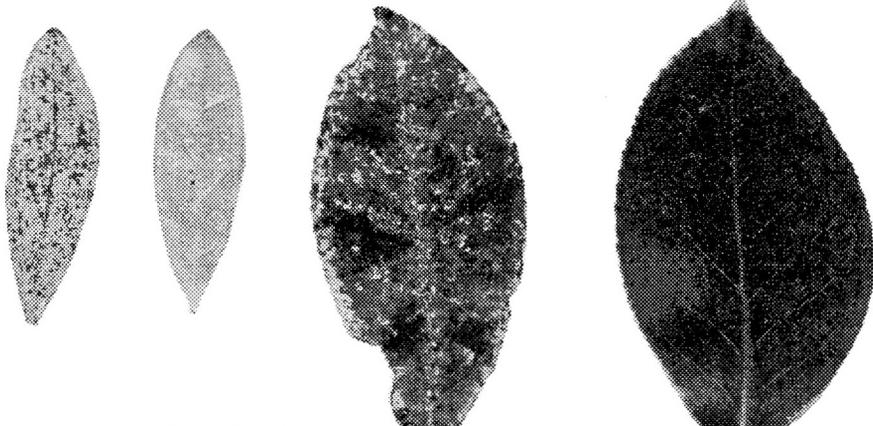
Soon the predatory mites (they attack the pest mites) arrived, in a small (about 500 ml) plastic tub, labelled *Phytoseiulus persimilis*. Inside were about 50-60 bean leaves, showing just the same sort of discoloration as my plant leaves.

I had been cautioned that these were living creatures which had to be put out straight



away, so I took the bean leaves out into the garden and stapled each of them onto the leaves of affected plants. The effects were remarkable.

The mite-affected leaves did not show any recovery, but the new leaves that the plants



Mite-affected and unaffected leaves of Azalea (left) and camellia

produced were free of markings, green and healthy. Obviously the magic spells were working.

There were not enough bean leaves for all affected plants, so the least affected ones did not have any stapled to them. However even these showed the same sort of new-leaf behaviour, so obviously the agent could spread itself around, something which can't be said of chemical sprays.

The treatment worked right through last Summer and Autumn, and so far this year still appears effective into late Winter (although

new-leaf production is minimal so far). But if the predators don't manage to overwinter and spread of themselves, I won't hesitate to order some more. A self-spreading antidote which works for at least a year is worth the \$40 involved to me.

Predatory mites are just one of the active, organic, plant-protection tools now available. The article following tells about more of them.

— *David Noel*

Eco-Echidna: A3507 (Phone 9336 6993).

[*Australian Horticulture* / 2004 May]

Good bugs and where do you get 'em?

Recent articles have mentioned insects, mites and nematodes (beneficials), which are biological control agents for some pests. Here is a list of the beneficials available for release in commercial crops and the companies that mass produce them.

Mass-rearing beneficial organisms is a complex process, and involves rearing the host (pest) species, which the beneficial feeds or breeds on, as well as the host plants on which the pest lives.

The Australasian Biological Control Association (ABC) was established in 1992 to bring together Australian and New Zealand commercial producers of beneficial organisms.

The commercial suppliers listed here are



A tiny Trichogramma wasp (<1 millimetre) stinging the eggs of light brown apple moth

members of the ABC. The association's main goals are to help reduce the level of pesticide usage by encouraging the development of Integrated Pest Management (IPM) strategies in a range of crops and to foster co-operation between producers of beneficial organisms.

Releasing good bugs

A good rule of thumb is if it's warm enough for the pest to be active it is warm enough for beneficials.

But remember that beneficial insects are as susceptible to pesticides as pest insects are.

Any of the predators or parasites you purchase will remain healthy in your nursery or greenhouse if there are no pesticide residues and there are low levels of pest insects for them to feed and breed on.

If there are no pests they will leave or die, if there are pesticide residues they will leave or die.

It is always best to release beneficials when pest pressure is beginning, not when pest numbers are at a maximum and actually causing damage to your plants.

A trial release of a small number of beneficials could be a good idea if you are not sure whether they will survive the conditions in your particular area. You will need to check on your beneficials regularly to make sure they have established.

Dr Paul Home of IPM Technologies Pty Ltd says: "Beneficials should not be seen as a substitute for pesticides but should be the basis of an Integrated Pest Management (IPM) system."

"A strategy needs to be worked out for the whole nursery or glasshouse, which would consider all pests, cultural methods used, and all chemicals (insecticides and fungicides) and their effect on beneficial insects. If for example you are trying to control whitefly in your glasshouse, there is no point spraying broad spectrum insecticides at the same time as releasing *Encarsia* wasps as one spray will kill your beneficials for three to four months."

Predators

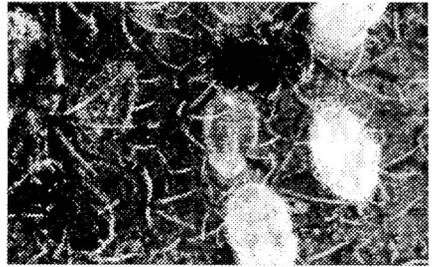
- *Green lacewing.*

The green lacewing (*Mallada signatus*) is a general predator.

The larvae of green lacewings will attack



Ferocious lacewing larvae camouflage themselves with debris and the bodies of their prey



You know Encarsia wasps have worked when whitefly nymphs turn black

and eat almost any small insect, including aphids of many species, two-spotted mite, whitefly, scales and mealybugs of various species, as well as moth eggs and caterpillars.

Lacewings have been found to be more effective outdoors than in greenhouses.

Green lacewings are available from Bugs for Bugs, and are usually dispatched as eggs or larvae in lots of 100 or 500.

- *Predatory mites.*

The predatory mite *Phytoseiulus persimilis* has been produced commercially for more than 20 years in Australia.

It feeds voraciously on all stages of two-spotted mite (*Tetranychus urticae*) and thrives in the warm, humid conditions found in glasshouses.

Commercial producers are Beneficial Bug Co, Bio-Protection Pty Ltd, Bioworks Pty Ltd, and Horticultural Crop Monitoring. The mites are dispatched on bean leaves in packs of 10,000.

Another predatory mite, *Stratiolaelaps (Hypoaspis) miles*, is available from Biological Services. The mites, commonly known as hypoaspis, dwell in the soil and feed on fungus gnat larvae, thrips pupae and springtails.

Hypoaspis are packaged in a pasteurised peat and vermiculite mix and are sold in containers of 15,000 mites at all life stages

(eggs to adult).

Also available from Biological Services is the predatory mite *Typhlodromus occidentalis*. This mite attacks spider mites, including the two-spotted mite. This mite is tolerant of hot and dry conditions and will even tolerate very low temperatures. It has been extremely successful in tree nurseries.

- *Mealybug predators.*

The cryptolaemus beetle (*Cryptolaemus montrouzieri*) is a type of ladybird. The adult and larvae of this beetle are predators of mealybugs and soft scale of various species.

They are mass-reared for commercial sale by Bugs for Bugs. They are available in punnets of 40 beetles or tubs of 500 beetles.

- *Scale predators.*

Scale-eating ladybirds feed on a range of armoured scale insects, including oleander scale, Oriental scale, citrus snow scale and red scale.



Phytoseiulus persimilis attacking two-spotted mites

Both the adult beetles and their spiny larvae feed on scale insects. There are two types available, the red chilocorus beetle (*Chilocorus circumdatus*) and the blue chilocorus beetle (*Chilocorus baileyi*). They are available from Bugs for Bugs usually as adult beetles.

Parasites

- *Whitefly parasite.*

Encarsia formosa has been used to control

Australian good bug producers

Beneficial Bug Co; Andy Ryland; Richmond, New South Wales; phone: (02) 4570 1331; fax: (02) 4578 3979; email: <info@beneficialbugs.com.au>; web: <www.beneficialbugs.com.au>.

Bio-Protection Pty Ltd; Robyn Coy; Kilmore, Victoria; phone: (03) 5781 0033; fax: (03) 5781 0044; email: <rcoy@hyperlink.com.au>.

Bioworks Pty Ltd; Matthew Parker; Nambucca Heads, NSW; phone: (02) 6568 3555.

Biological Services; James Altmann; Loxton, South Australia; phone: (08) 8584 6977; fax: (08) 8584 5057; email: <fruitdrs@sa.ozland.net.au>.

BioResources Pty Ltd; Richard Llewellyn; Samford, Queensland; phone: (07) 3289 4919;

fax: (07) 3289 4918; email: <richard@bioresources.com.au>; web: <www.bioresources.com.au>.

Bugs for Bugs (Integrated Pest Management Pty Ltd); Dan Papacek; Mundubbera, Qld; phone: (07) 4165 4663; fax: (07) 4165 4626; email: <info@bugsforbugs.com.au>; web: <www.bugsforbugs.com.au>.

EcoGrow Australia Pty Ltd; Craig Wilson; Bondi Beach, NSW; phone: (02) 6257 0577; fax: (02) 6257 0599; email: <info@ecogrow.com.au>; web: <www.ecogrow.com.au>.

Horticultural Crop Monitoring; Paul Jones; Caloundra, Qld; phone: (07) 5491 4662; fax: (07) 5491 4662; email: <pjones@hotkey.net.au>.

greenhouse whitefly (*Trialeuroides vaporariorum*) in commercial greenhouse crops for more than 50 years. Encarsia are packaged on cards containing about 100 parasitised black scale (whitefly pupae). They are available from Biological Services and Bioforce Ltd (New Zealand).

• *Moth egg parasite.*

Trichogramma wasps are tiny moth egg parasites that are produced commercially in many countries to control a range of moth and butterfly pests.

The main target pests of *Trichogramma* in greenhouses are budworms (*Helicoverpa armigera* and *H. punctigera*), light brown apple moth (*Epiphyas postvittana*) and loopers (*Chrysodeixis* spp.).

The wasps are usually dispatched in the form of parasitised moth eggs either loose (at more than 50,000 parasitised eggs per gram) or in capsules of 1000. Sales enquiries should be directed to BioResources Pty Ltd.

Other parasites available are *Aphytis*, a scale parasite available from Bugs for Bugs and Biological Services; and *Leptomastix*, a citrus mealybug parasite also available from Bugs for Bugs.

Nematodes

Entomopathogenic nematodes are microscopic roundworms that attack the larval stages of insects.

The nematodes are attracted to the insect by its carbon dioxide exhalations; they enter the larva through its body openings and kill it by releasing a bacterium, which multiplies inside the larva.

The nematodes *Steinernema feltiae* are effective against the larva of the fungus gnat (*Bradysia* spp.) and are applied with water to the growing medium after planting.

There are also nematodes available for several beetle grub turf pests such as cockchafer. The nematodes are available from EcoGrow Australia Pty Ltd.

Future good bugs

There are several beneficials under development for commercial release in Australia including assassin bugs, damsel bugs, ladybirds and thrips predators.

More information

The ABC has recently released the second edition of *The Good Bug Book*.

The book describes all the available beneficial organisms in detail, where to buy them and how to apply them.

The book is available through the ABC website: <www.goodbugs.org.au>.

— *Denis Crawford*

[Denis Crawford is a freelance writer, photographer and consultant from Victoria with an extensive knowledge of horticultural and agricultural insect pests.]

Australian Horticulture: A1050.

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Australian research on Andean Walnut, *Juglans neotropica*

Quandong readers may be interested in some recent work on this tropical walnut, which originates in the highlands of South America.

For several years we have been doing the straightforward cross-pollinating while the serious side has been carried out at the University of West Sydney.

The aim, we understand, is to produce rootstock varieties more suitable to Australian conditions. We are provided with the pollen to put onto our *J. neotropica*, as we have a significant number of trees at various stages of growth

Pollen used on the *J. neotropica* came from the following species/clones:



Younger pruned trees, recent photo



J. hindsii (Hinds Black Walnut, California)

J. regia/nigra cross (Nigra is Eastern Black Walnut, USA)

J. regia (Persian Walnut, unspecified)

J. regia (Persian Walnut 'Franquette')

On our *J. regia* (Franquette) trees, *J. neotropica* pollen is used.

The resultant nuts, and leaves from the growing plants of crossed origins, are returned to the University of Sydney for DNA testing to establish whether or on a genuine cross has occurred.

I understand that self-fertilisation can occur sometimes if the "foreign" pollen is rejected.

Pruning for timber

Our initial orchard of *neotropica* grew

rapidly, but as we did not prune the trees, they spread their limbs in a fashion unsuitable for timber production. Subsequent plantings, with vigorous pruning, have produced tall fast-growing trees without apparently affecting nut production.

Our reference (*Lost Crops of the Incas*, National University Press, 1989) indicates that the timber is in great demand as a high-quality furniture wood.

[From Leo Manuel's Rare Fruit site,
<rarefruit@san.rr.com>]

An exchange on Chinese *Arbutus* and *Arbutus unedo*

Subject: *Arbutus unedo*

I think, without a doubt, that a can of these from China were, incontrovertibly, the worst things I've ever eaten out of tinned/frozen/canned vegetables or fruit! I grow a tree of it, but, apart from trying one every five years just to remind myself of what a fantastically misleading name it is (Strawberry Tree — life must have been tough in Ireland!), I don't bother to eat them.

— **John Prince**, Nestlebrae Exotics, 219 South Head Road, Parkhurst, RD1 Helensville, New Zealand 1250. phone [64] 09 420 7312, email nestlebrae.exotics@xtra.co.nz, website: www.helensville.co.nz/nestlebrae.htm

Subject: Chinese *arbutus*

I saw your comment and wondered if you knew that 'Chinese *Arbutus*' is not from any *Arbutus* species, but is a bayberry (*Myrica*) fruit, not related. If you still have some from the can, you might notice that each fruit has a single large central seed, not scattered small seeds as in Irish Strawberry.

I quite like the flavour of fruit from my

Nuts available

We have selected seed nuts available from trees producing the larger fruit. They are priced at \$1.00 per nut, plus GST and postage.

— **Rod Macdougall**

A1656: R & M Macdougall, RMB 1328 Fernlea Road, Denmark, WA 6333. Phone: 08-98409293, fax 08-98409293.

Arbutus unedo (species name *unedo* said to be Latin for 'you only eat one'), although they are rather mealy. There are many related species, including one from Mexico which has large bright red fruit, said to be somewhat narcotic!

— **David Noel**

Subject: re: Chinese *arbutus*

Aha! WA is not just a mine in the mineral sense: it's that mine of information also!

I can't be sure on this one, because it would be at least 10 years ago — which means that, no, I don't still have the can and a few left over fruits!

However, I don't specifically remember the large central seed, and the fruits did look very much like *A. unedo*. Labelled as "*Arbutus*"

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or suchlike from memory, and with a Chinese firm's name on the label. Anyway, I've only ever seen them once since then, so will look with interest if I ever come across them again.

I dimly recognize your reference to the bayberry fruit. Perhaps I read about that in a "Quandong", or in a CRFG story once. Most likely places. I tried several times to germinate *Myrica nagi* (again, this is from memory) seeds from Chiranjit Parmar in the period when it was easy to import anything into NZ. Never had any success germinating them, but, if that's the fruit quality, then it isn't that much

of a loss, I guess.

We've just eaten the first *Eugenia uvalha* fruit of this season — we really like them. Best of the myrtaceous fruits growing on this property, I reckon. Also two days ago we found the first *Eugenia aggregata* fruit (the shrubs have been flowering for years, but never a fruit till now.) And one of the Wampis has set fruit for the first time. And I've got Miracle Fruit on a plant I'm holding in the glasshouse for the first time. Exciting (by our standards, anyway).

– John Prince

An analysis a couple of years ago suggested that avocados had a potential oil yield per hectare twice that of olives, and that the oil was an excellent culinary product. The following article brings out the health benefits of avocado oil.

[*The Orchardist* (New Zealand) / 2003 Oct]

Cold pressed avocado oil — a healthy development

Although avocado oil is not a new product, "Cold Pressed Extra Virgin" avocado oil is a new exciting development on the shelves of international and local supermarkets.

Extra virgin avocado oil is the "new wonder oil" with a wide range of human health benefits. HortResearch, Massey University and Olivado, a New Zealand avocado oil processing company, are currently undertaking research to identify the health components of this new oil and making sure those components are maximised during commercial extraction and product shelf life.

They say, "Our results show that avocado oil is indeed a healthy oil, possibly even more so than olive oil. We think avocados should be promoted for the nutritious benefits of both the oil and the fresh fruit, and for the health of consumers."

Extra virgin avocado oil is pressed at low temperatures and has unique culinary and

health properties. Its extraction process preserves the health benefits damaged during traditional avocado oil extraction, which is carried out using organic solvents and/or high temperatures complemented with refining and deodorising steps.

While these processes remove any undesirable degradation products from poor quality fruit and produce oil that is clear with good stability, the oil has little taste and diminished health benefits. These refined oils are predominantly used in the manufacture of cosmetics and skin care products as they contain vitamin E (Alpha-tocopherol).

To produce extra virgin avocado oil you need good quality fruit. Cold pressing of avocado oil preserves the fruit's aromas and

health benefiting components and gives a bright green, high quality, good-tasting oil. This oil is now finding favour in many restaurants and homes for cooking and in salad dressings.

Food processing companies in New Zealand have recently developed commercially viable cold press extraction techniques. Since the oil is extracted from the flesh, the fruit must be first ripened and the flesh separated from the skin and seed. The fresh fruit is ripened under controlled conditions

and thus, few enzymes are released when the cells are destroyed in the extraction process. These enzymes are responsible for the loss of quality and flavour in oils. The oil is released from the pulp and recovered by centrifugal techniques.

In order for oil to be termed cold pressed, the steps in the extraction process are carried out at temperatures under 50 °C. Controlling the temperature results in a superior quality extra virgin oil with very low acidity and rancidity.

Medical and nutritional research show that oils and fats are an important and essential part of our daily calorific intake. In developed countries, the daily energy requirement is fulfilled from food groups such as dairy and meat products, eggs, cereals and grains, plant foods, cooking fats and sugars.

In New Zealand, fats from animal origin constitute almost 70 percent of the total fat in the diet. While we are required to eat fats and oils to assist the body's performance and



HortResearch personnel sampling and "flash freezing" avocado tissue for later analysis

development, it is becoming increasingly clear that we need to be mindful of the quantity and especially the quality of the oils we consume.

Health problems, particularly heart disease, have been associated with poor eating habits. Animal fats are generally high in saturated fats and cholesterol while oils from plants are generally low in saturated fats and have no cholesterol. National and international health organisations recommend reducing the intake of saturated fats and cholesterol and replacing those with quality plant oils. To achieve a complete nutritious balanced diet that provides energy, essential lipids and antioxidants, most consumers need more information on their choice of edible oils.

Fatty acids

Oils from fruits such as avocado are comprised of healthier fatty acids than other edible oils. Fatty acids are the "bricks" that make up an oil which are important for a healthy heart.

The avocado is the only commercially

significant tree crop with an oil content similar to olives. Avocado oil, like olive oil, contains mostly unsaturated fatty acids (72 percent), with approximately 66 percent of this being the healthy monounsaturated oleic acid.

Consumption of monounsaturated oils has been demonstrated to be cholesterol-reducing as supported by studies conducted in Mediterranean communities where olive oil is the main form of fat consumed. In Greece, saturated fatty acid intake is low (<10 percent of energy) and despite a moderate to high intake of total fat, blood cholesterol concentrations are low, as is the incidence of coronary heart diseases.

Alpha-tocopherol and Beta-sitosterol

Avocado oil produced in New Zealand contains a wide range of compounds that are known to have health benefits. Of importance is Alpha-tocopherol (vitamin E), an essential vitamin recognised as a powerful antioxidant. Alpha-tocopherol prevents the formation of free radicals from the body's normal oxidation processes and is associated with the reduction in the incidence of cardiovascular diseases and some forms of cancer.

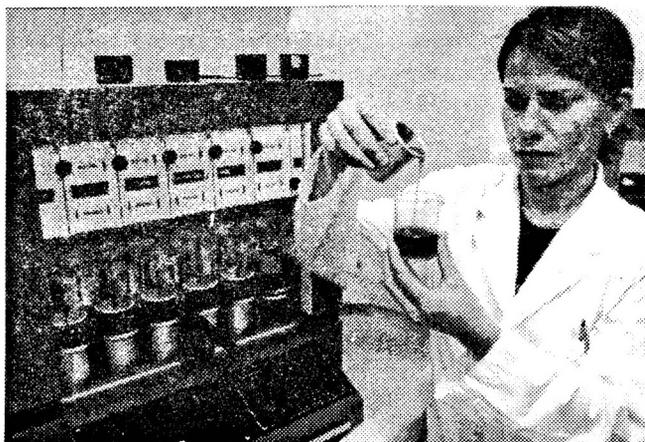
The level of Alpha-tocopherol measured in New Zealand cold pressed avocado oil is approximately 120-150 (units of micrograms/g). This is very favourable in comparison to olive oil, which typically has levels of approximately 100-140.

Alpha-tocopherol is naturally very unstable and can be destroyed if not carefully processed. Cold press extraction methods retain higher levels of this compound than extraction and refining methods that use chemicals and heat. Retaining Alpha-tocopherol is also important for long oil shelf life as it prevents the oxidation of the fatty acids that cause the oil to become rancid. There is circumstantial evidence that the consumption of rancid oils is correlated to diseases such as inflammatory diseases or cancer.

Another important compound present in avocado oil is Beta-sitosterol. This compound is the most abundant in the group of naturally occurring compounds called plant sterols. Beta-sitosterol is soluble in fat and concentrated in the oil of the avocado. This compound is found to have a beneficial effect

on lowering blood cholesterol levels by inhibiting intestinal cholesterol absorption in humans. There is also evidence that Beta-sitosterol may reduce the risk of prostate cancer at least in animal studies, and it has been associated with reduced prostate inflammation in humans.

The role of plant sterols in maintaining human health is supported by the recent introduction of margarine spreads with added plant



Extraction of avocado oil to determine available oil content and composition

sterols. These products have gained international acceptance and have captured space in a competitive market despite their premium prices. Beta-sitosterol levels in New Zealand cold pressed avocado oil are approximately 450 mg/100g, which is significantly higher than that in olive oil (approximately 250 mg/ 100g).

Olivado NZ Ltd. is working with HortResearch to determine the effect of fruit, processing conditions and storage on Alpha-tocopherol and Beta-sitosterol levels.

Antioxidants, Pigments, Lutein

In addition to vitamin E, cold-pressed avocado oil contains pigments such as carotenes, xanthophylls and significant amounts of chlorophyll. These pigments act as antioxidants and provide protection from diseases by neutralising reactive free radicals that cause damage to tissues in the body. The most important of these pigments in avocado oil is a compound called lutein, which has a particular relevance to eye health, acting in the macular region of the retina.

The macula is the central region of the retina and it preferentially accumulates two pigments: lutein and zeaxanthin. Age-related macular degeneration (AMD) is the leading cause of loss of vision in the elderly and these pigments are believed to protect the cells of the macula from light-induced damage. As these pigment compounds cannot be made in the body they must be obtained from the diet.

Recent studies have shown that when lutein or zeaxanthin are included in the diet the progression of AMD is reduced. In our studies we have found that avocado oil contains approximately twice the amount of lutein as olive oil.

The recent world revolution to promote consumption of plant oils was triggered from

evidence of longer life and healthier individuals in the olive oil producing regions. Slowly, consumers are becoming more conscious that the type of fat consumed affects cholesterol levels. The average serum cholesterol in New Zealand is 5.7 mmol/litre per capita, which is very high compared with other countries and is associated with the fact that New Zealand is number four in the world ranking for deaths from coronary heart diseases.

Refined vegetable oils provide no added benefits over their use in cooking (more like a lubricant to our food). Quality extra virgin avocado oils can be used for cooking and also to deliver important nutrients to the body. Two-thirds of the fat in avocados is the 'good fat' that does not raise cholesterol. In addition, the components in avocado oil, as mentioned above, can help lower cholesterol in the blood and provide the body with other beneficial compounds.

The case for increased consumption of this good oil is compelling.

— *Cecilia Requejo*, HortResearch, Mt Albert Research Centre, Private Bag 92169, Mt Albert, New Zealand, and 5 colleagues.

The Orchardist: A1759.

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(*Fruit Gardener* (California Rare Fruit Growers) / 2004 Jan-Feb)

The 'Holiday' avocado

Q. What can you tell me about the 'Holiday' avocado that is currently appearing for sale with glowing commercial advertising? — Richard Watts, California.

A. The 'Holiday' avocado was a selection from the avocado breeding program at the University of California Field Station in Irvine, when it was under Dr. Bergh's supervision.

It was chosen for the large, plentiful fruit that developed on a juvenile tree, then later ignored because the fruit was too large, the skin colouring green and the tree was quite small.

It was offered to Australian farmers in a group of avocado varieties. They rejected it because it was a "ground crawler."

I started studying it in 1992. The fruit was plentiful, delicious and available in winter, when few other varieties were at peak season. The old trees had never been pruned and were still a nice size to pick from without using ladders or a very long pole. The perky, green-skinned fruit peeled easily and averaged about 650 gm. It was called 'XX3' at that time.

Because it was recognized that this variety would be better for the backyard than currently available varieties, a letter was sent to major wholesale nurseries to see if they were interested in it. Darling Nursery was the sole respondent, but they wanted a more attractive name for a sales campaign.

I suggested 'Holiday' because the fruit ripened from Labor Day through New Year's Day. Darling agreed to sell to Armstrong Nurseries exclusively for one year in exchange for advertising. Public interest in these trees far exceeded the supply, but now more of them are being propagated and offered at other nurseries.

Some of the trees propagated two years ago for a budwood supply have set as many as 20 fruit at one year. They will be ready to harvest next fall — it takes about 16 months for the fruit to mature.

To ensure acceptance of the 'Holiday' avocado, my husband and I delivered samples to the main Armstrong Nursery and to all the area nurseries for sales people to sample. It then became an easy sell.

— *Julie Frink*, Avocado Specialist
Fruit Gardener: A2886.

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[West Australian / 2004 Jun 17]

WA success with avocado oil, pulp

Avocado growers John Hallion and Gillian Arthur, of Carabooda [25 km north of central Perth], believe they have come up with a healthy alternative for frying, roasting and drizzling on freshly baked bread.

Their first pressing of extra virgin organic avocado oil sold out last year and won a WA Health Department 2003 Nutrition Award for innovative and healthy food.

It is just the start of a new venture for Hallion and Arthur, who run the Good Oil Farm and supply thousands of tray-loads of organic Hass avocados to speciality retailers, delicatessens and greengrocers in peak season, September to December, around Perth.

They have already made their mark in the area by winning a City of Wanneroo new business award and plan to introduce a range of reduced fat avocado products this year with an innovative high-pressure cold processing technique to stabilise the 10,000-12,000 kilograms of pulp left over from oil production, which would otherwise spoil within hours of processing and end up as mulch.

"To allow these products to move forward, the avocado pulp requires stabilisation," Hallion said. "Unfortunately, when avocado by-product is heated above 50 C it becomes bitter and loses its texture, ruling out any heat pasteurisation to control bacteria".

"Trials have resulted in an exciting and unique range of foods, including avocado mustard, avocado mayonnaise,

avocado sorbet, guacamole and avocado salad dressing, which many celebrated chefs, focus groups and store buyers have endorsed for their health benefits."

Hallion, a consulting engineer, also hopes to introduce a vacuum packed and pressure treated long-life ripe avocado, which would have a fridge life of four weeks.

"We have done a lot of work with the CSIRO on this process, which was developed in the US and is being used on avocados



Gillian Arthur and John Hallion at their Good Oil Farm. Picture: Ken Maley

grown in Mexico for the North American market," he said.

The possibilities are endless with avocados, a native of Mexico, where they are called butterfruit and added to soft tacos. Brazilians use them in ice cream, Indonesians add milk and coffee to make a cold drink and Jamaicans flavour the pulp with lime juice and chillies for a nutritious iced soup.

There are several varieties, with the bumpy skinned Hass named after a Californian postman who first cultivated it in the 1920s.

The cold pressed oil is cholesterol free, rich in antioxidants, monounsaturated fats, vitamins and minerals. Its rich emerald green colour is attributed to lutein, an important carotenoid which can protect against eye diseases such as cataracts and macular degeneration.

Delicious drizzled over warm Turkish bread, it has a smoke point of more than 280 C, which makes it excellent for high-temperature cooking because it seals in natural juices and goodness without burning the food or leaving it stuck to the pan.

Dale Sniffen, chef at Herdsman Fresh Essentials, said it could sustain heat in a similar way to grapeseed, peanut and soya bean oils, but had the advantage of blending flavours, much like olive oil.

"A drop goes a long way," he said. "You don't pour it into the pan, but smear a little on whatever you're cooking. Ideally, it's the sort of oil you drizzle over a steak, maybe mixed with some garlic or chilli, and the best way to appreciate the unique buttery flavour is to

pour some into the palm of your hand, let it warm to body temperature, then taste."

Arthur said she basted vegies and turkey with avocado oil in the Webber last Christmas and didn't have to cover anything with foil. "The oil enhances the flavour of the food, but doesn't overpower it," she said. "We use only the flesh, without the skin and seed which contain tannins and toxins, so there is no heaviness or greasiness."

Arthur, a former catering technician, started growing avocados 15 years ago to keep her water licence. "There was nothing here, except a shed," she said. "I wanted to have the water licence transferred from my horse property in Mariginiup, but was told I would need to have a commercial crop in and growing within six months to do that.

"Being pregnant at the time, I couldn't see myself crawling around a vegie patch, so opted for avocados. The Hass variety were a good choice to grow organically because they are not attacked by fruit fly or birds."

Making oil is labour intensive. With 500 trees, including 100 recently planted Lamb Hass, which produce big 400-600 gm fruit, the picking, sorting, ripening, processing and bottling take place in three to four hectic months at the end of the year.

Only small supermarket size fruit and seconds are used, a venture born of disappointment with wholesalers and big chain stores who weren't handling, storing and displaying the organic avocados properly.

That prompted Hallion and Arthur to take on marketing and distribution themselves to ensure quality control and education of retailers while leaving a stockpile of avocados.

The couple expects to produce about 1200 litres of oil for the WA market this year.

— *Olga de Moeller*

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[*The Orchardist (New Zealand) / 2004 Jun*]

Cherries grown hydroponically in bags

Anyone involved in horticulture has to be prepared for challenges and as procedures and technology have changed and developed, there are orchardists willing to tackle innovative methods.

At the top of the Earnsclough flats, near Clyde, fruitgrower Kevin Paulin freely admits he is a horticulturist who enjoys a challenge.

While trees are grown in the traditional and conventional manner at the Paulin Alpine Packhouse orchard in Central Otago, there is a small 2 ha block of cherry trees being grown in bags.

Kevin says it is early days yet for the block, but several hundred trees were being grown under conventional orchard practice, except for outdoor hydroponic control.

He sees the challenge of growing cherry trees in polythene bags and has been in contact with a Blenheim grower, who has significantly more than the Paulin block.

Some of the Sweetheart" variety cherry

trees at Earnsclough are four years old, others are half that age.

The trees receive all nutrients hydroponically and because of the need for regular monitoring of the systems, labour requirements are greater than the traditional method.

Savings on bird protection

However, by intensively growing the cherries in a smaller area, the ledger is balanced by the savings in the capital cost of overhead protection from birds.

"A few hundred" of the four-year-old trees have been covered by a net canopy, Kevin said.

There has been a small trial export of some of the fruit harvested off the older trees, but at this stage production volumes from the total block were still small.

One of the benefits of the intensive planting and necessary monitoring of nutrients through hydroponics, was the more immediate response from any work carried out.

Part of the continuing challenge would be growing cherries of equal quality as in the traditional and conventional method



Trees in bags at Kevin Paulin's orchard, Earnsclough, Central Otago. Photo: Dianne King

of planting directly in the ground.

"One of our findings, so far, is we are able to get the size but we need firmness and flavour from fruit grown on the trees in bags."

Because of the height of the bagged trees, cherry harvesting was easier. "We're trying to keep trees lower," he said.

He is relaxed with the progress of the block to date and emphasised the block of cherry trees in bags was definitely not an experiment.

— *Dianne King*

The Orchardist: A1759.

[*MOTTO (Men of the Trees) / 2004 May*]

MOTT carob pods go to the Zoo

Many years ago Henry Esbshade planted a trial crop of Carob Trees at St Barbe Grove Nursery. Every Monday, when they are in season, I collect up the Carob Pods and take them to the Zoo.

Last Monday, with the help of Henry's son Theo, Greta Edwards, and my grandchildren, we took a wheelbarrow to find all the Carob Pods and set off once again for Perth Zoo.

While usually we just drop off the Pods, this time we were lucky and met Kathy, a friendly zoo worker, who was kind enough to show us through a gate marked 'Zoo Staff Only' (making us feel very special) and into the food preparation building.

The food preparation area was pristine, making most café kitchens look positively grotty! It had spotless stainless steel benches and a marvellously decorated blackboard, upon which was chalked up the menus for all of the animals. My grandchildren were most delighted to read:

Crocodile: 2 whole fish 1 chicken

Numbats: 200 grams live termites

Another section of the food preparation area contained huge hoppers full of pellets for the Ungulants or hooved animals and 'others' (I wonder what the 'others' were?).

Our Carob Pods were mixed into several feeds, but it is the giraffes who love them best!

— *Jo Hiller*

MOTTO: A3009.

On the WANATCA Executive

Your Executive Committee welcomes new member Simon Barnett, who brings valued business experience to the Committee.

Simon replaces John Allert, who has had to resign due to academic workload, and also John Cory (who isn't sure how his name ever got onto the list), also due to pressure of business. Luckily, John is staying on as our Macadamia Action Group Leader.

That still leaves a vacancy for anyone else interested in helping out on the Committee....

"Nuteeriat" and "Matrix Thinking" free PDF downloads

Those interested might like to know that full-text copies of my books "Nuteeriat" (Nut Trees, the Expanding Earth, Rottnest Island and All That ...) and "Matrix Thinking" are now available as free PDF downloads at:

www.aoi.com.au/matrix.

— *David Noel*

[Ground Cover (GRDC) / 2004 Jun]

Peanuts — An industry on the move

Grab a handful of peanuts, a Mars bar, or spread your toast with a thick layer of peanut butter — and you are about to taste an industry on the move.

Australia's peanut industry is expanding, and while it is currently worth about \$200 million a year, production is moving into new regions to meet growing domestic demand and niche export opportunities.

"Peanut production is one of the bright lights on Australia's agricultural horizon," says Queensland Department of Primary Industries and Fisheries (QDPI&F) principal agronomist and GRDC-supported peanut programs' supervisor, Dr Graeme Wright.

"Demand is currently around 50,000 to 60,000 tonnes (raw nut in shell), and the industry is looking to new regions with irrigation and suitable soils for more reliable and consistent production."

Burnett grower Wayne Weller shares the general optimism surrounding the industry. "In most years we cannot meet demand and peanuts are imported to make up the deficit," he points out. "Our future looks good, but our survival still depends on our efficiency."

Peanuts are a high-input crop needing close monitoring, but Mr Weller says they are also reasonably low risk. "You would rarely get a complete failure with a peanut crop. In



Not just peanuts: an expanding industry

25 years, we have only had two complete failures, resulting from a wet harvest, and even then only in certain fields."

One of the reasons for the increasing demand for peanuts is the expanding knowledge about their health and nutritional values. Peanut butter has long been a fallback for parents of fussy eaters — and for good reason. Research shows peanuts are a complete food, high in good oils, carbohydrates, protein, vitamins and minerals.

Lately the news has been even more

positive. Researchers have been breeding even healthier peanut varieties, with high oleic traits.

"High oleic is a monounsaturated oil, which has significant health benefits and can also increase the shelf life by up to six months," Dr Wright says.

The high oleic trait was first identified in a University of Florida breeding line. This line had no other desirable traits, but was crossed with commercial varieties in Australia and the USA to produce high oleic peanut varieties.

Peanut Company Australia (PCA) managing director Bob Hansen believes the high oleic factor is a major reason for the increase in demand for peanuts. "Manufacturers have more confidence in using peanuts in their products since the release of

new high oleic cultivars. The high oleic trait means the nuts are more shelf stable so manufacturers are more comfortable using them without fear of product spoilage," he says.

"Freshness and taste are vital, so peanuts with longer shelf life are highly sought after in the marketplace. Australia has a market advantage because we are the country most actively developing high oleic varieties."

Strong and growing market demand is driving the expansion of peanut production into new regions in northern Australia.

The Northern Territory offers continuity of supply through irrigated cropping, while traditional cane growing regions in Queensland are turning to peanuts as a high-return rotation crop. In the future, peanut production may even spread south.

"NT's friable sandy soils are ideal for peanut harvesting," says Dr Wright. "And with plenty of water available for irrigated cropping, peanuts can be produced from March to September, out of the traditional season."

Continuity of supply brings significant advantages for peanut shelling and processing plants. Having a year-round supply of fresh peanuts means increased stability and production efficiencies.

Operators are also able to meet market demand and explore new export opportunities.

"The industry requires consistency of supply and quality. This puts emphasis on high input production (irrigated) areas, because we really need growers to underpin supply and quality," says QDPI&F principal extension officer for pulses, Greg Mills.

Also, PCA, which is Australia's largest peanut processor, is looking to spread risk across several regions. PCA processes a

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significant proportion of Australia's peanuts and is the driving force behind the move into the Northern Territory.

"We have invested \$2 million in developing a farm and the infrastructure needed to support the industry in Northern Territory, such as drying facilities. NT's 'out of season' supply means we can use our processing facilities all year round," says managing director, Bob Hansen.

Meanwhile, back in Queensland, peanuts are finding a new home in the cane industry as an ideal, high-return rotation crop.

"Research has highlighted the role of peanuts in breaking cane monoculture. Because peanuts are a legume and return biologically fixed nitrogen back to the soil, they can improve soil health and boost cane yields," says Mr Mills.

"Cane growers have very few field crops they can enter into. Peanuts and soybeans lead the charge — but peanuts grown well are more profitable than soybeans."

Mr Mills says there is no cutting corners with peanuts, but the opportunities are there for growers who want to invest time in more intensive crops.

"Peanut crops need to be managed more like a horticultural crop than a grain crop. They can achieve high yields and relatively high returns while providing substantial benefits to their cropping systems," he says.

New varieties for the South

New varieties may also open up new areas in the south.

At QDPI&F in Kingaroy, peanut breeder Alan Cruickshank has been developing early maturing peanut varieties, which were originally bred for better drought resistance.

"These varieties also have the potential to be grown in southern states, including New South Wales, Victoria and South Australia," Mr Cruickshank says.

But can the market support the expansion into new regions, or will traditional growers lose out? Grower Wayne Weller believes it will only make the industry stronger.

"Northern Territory producers are well positioned, geographically, to supply Southeast Asian markets, while Queensland is better positioned to supply domestic demand," he says.

Greg Mills agrees: "An increased and wider spread of production will enhance the sustainability of the peanut industry in Australia."

"The industry needs critical mass. It needs higher throughput to justify investment in cutting edge processing. More peanuts make it good for everyone."

While peanuts are a robust and well-adapted crop, they are responsive to good crop management; a fact reflected in increasing yields through modern farming practices.

"It is a crop that suits our farming systems and soils, and we've been able to put additional management practices in place to increase yields and reduce contaminants," says Mr Mills.

— Louise Ralph

(GRDC RESEARCH CODE: DAQ 534, program 2).

For more information: Dr Graeme Wright, 07-4160 0700, Graeme.Wright@dpi.qld.gov.au. ¥

Terra Preta roundup — Amazonian Earth

A soil-improvement technique developed hundreds of years ago by the native inhabitants of South America has the potential to give dramatic increase in yields and sustainability at minimal cost.

Called 'Terra Preta' (Portuguese for 'Black Earth'), the technique involved raising the carbon content of the soils by incorporating charcoal, apparently by putting burning plant matter in the ground and covering it with soil, so that it charcoalizes instead of burning to ash.

In my opinion, this may one of the most important horticultural discoveries, or rediscoveries, of the last century. It apparently gives soils which greatly boost plant yields and remain continuously fertile over many years, instead of needing fallowing or addition of synthetic fertilizers.

The articles which follow give more detail on what has been found out. What is not covered there, however, is any research program to convert our current Australian soils to the improved form. It seems to me that such research merits a great push, with its potential to improve sustainable plant growth over the long term without chemicals.

At least three approaches are possible.

The first is to imitate the Amazonian technique and put burning tree material into soil-covered pits, or cover burning windrows with soil.

For the second and third, I am starting my own small experiments, adding carbon to soil mixes used in nursery pots and observing whether growth is improved. I bought some 'barbecue charcoal' to break up and add, but this appears to be aggregated into briquettes using tarry materials, likely to harm plants. So I am looking for a commercial source of loose charcoal.

The third way is to add activated carbon (derived from finely-divided charcoal) to the mix. Activated charcoal is sold by aquarium shops for water filtering, but is an expensive source. However, big quantities of activated charcoal are used by the mining industry — as I understand it, in gold refining — so I am looking for a cheaper source there.

Don't leave it all to me, have a go yourself — the rewards all round could be dramatic.

— *David Noel*

[Fruit Gardener (California Rare Fruit Growers) / 2003 Jul-Aug]

Amazonian Dark Earth

Centuries before Columbus arrived in the New World natives of the Amazon basin were terraforming the region. Terra Preta de Indio is the local name for swaths of dark earth characterized by high carbon content, extremely high fertility and peppered with shards of broken clay pottery.

Many of these fertile regions remain today and are under study to learn how they were developed and why they have maintained their fertility over the centuries.

Biomass and fertility

In spite of the exuberant growth of rain forests, tropical soils are notoriously low in organic material and essential plant nutrients. The majority of nutrients present in tropical ecosystems are tied up in the biomass that covers the land rather than in the sandy soil itself.

And when chemical fertilizers are added, tropical rains leach them out of the soil within a few years. The common practice of "slash-and-burn" agriculture is a way of adding fertility for two or three years, but the soil is soon exhausted and farmers must move on to new areas of rain forest. However, the ancient Amazonians found ways of enriching the soil so that that it retains its fertility two thousand years later.

Pre-Columbian agroforestry

Long-term fertility would have been crucial to cultures that had the use of only stone tools for clearing forests. The labour required to clear land would mean that early Amazonians would have stayed with a piece of land for an extended period of time and they would have utilized agricultural practices very different agricultural from those that are currently the norm. Indeed, pre-Columbian Amazonians appear to have practiced primarily agroforestry. Analyses of one Amazonian site found remains of about 30 species of useful trees.

Rather than regarding these ecosystems as untouched and pristine, Brazilian plant geneticist Charles Clement considers the

lowland tropical forests of South America to be "among the finest works of art on the planet." He says the Amazonians developed forests of tremendous diversity: fruits, nuts, and palms. The forests produced many essentials needed in a sustainable ecosystem without the annual investment of labour required for growing annual crops exclusively. And the tree canopy provided shade beneath for annual crops that prefer some shelter from intense tropical sunshine.

Terra Preta: Black Earth

Terra Preta, or black earth, can be found on low hills overlooking rivers of the Amazon basin. More than 10 percent of Amazonia may be terra preta — an area the size of France. Archeologists from the University of Sao Paulo have dated the oldest deposits in the lower and central Amazon to the time of Christ. Younger terra preta deposits, 500 to 1000 AD, are found upriver. Not all cultures in the Amazon basin produced terra preta, but many did; similar deposits are scattered throughout South America.

Black-earth regions typically cover one to five hectares, but some can be 300 hectares. Black soils average about half a metre deep,

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The website for the on-line version of past and new WANATCA Yearbooks is now in operation. It is at:

www.aoi.com.au/wanatca/Yearbook

Open to all Web users, this site has an index of all papers published in the printed version of WANATCA Yearbook in the years 1974 to 2002.

These papers in their full form are being progressively converted to PDF files which

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but in some regions are more than two metres.

Terra preta has more available nitrogen, phosphorus, calcium and sulfur than surrounding soils. It contains much more organic matter and retains moisture and nutrients better.

Up to 70 times as much charcoal is found in terra preta, a key to long-term fertility according to Bruno Glaser, a chemist at the University of Bayreuth, Germany: "The charcoal prevents organic matter from being rapidly mineralized. Over time, it partly oxidizes, which keeps providing sites for nutrients to bind to."

Scientists studying terra preta development refer to "slash-and-char" as opposed to slash-and-burn. They believe that rather than completely burning organic matter to ash, as is the current practice, ancient Amazonians burned wood incompletely to form charcoal and mixed the resulting charcoal with the soil.

In preliminary trials of developing terra preta, plots treated with charcoal and fertilizer produced up to 880 percent more growth than plots treated with fertilizer alone.

But charcoal alone offers few plant nutrients. Glaser speculates that amendments such as turtle, fish, animal bones and dung were also necessary to provide essential nutrients. Terra preta deposits are generally filled with clay-pot shards. The purpose of pottery fragments is unknown, but fuels interested speculation by terra preta archeologists.

Microorganisms important

Terra preta also contains extremely high quantities of microorganisms. Eduardo Neves of the University of Sao Paulo believes Amazonian peoples inoculated poor soil with the requisite bacteria, much as a baker adds sourdough "starter" to dough in making sourdough bread. Modern Amazonians quarrying terra preta for potting soil never remove the bottom third of the dark earth layer, explaining that over time terra preta will regenerate to its original thickness.

Ecologist Janice Theis of Cornell University believes microbial mass plays a role in continued terra preta fertility. She speculates that scientists may be able to create a "package" of charcoal, nutrients and microfauna to transform tropical soils into terra preta. The possibility of creating modern terra preta deposits interests environmentalists as well as farmers.

Soil carbon is an important carbon pool in the global biogeochemical cycle, and about one-third of the carbon in terrestrial ecosystems is found in tropical soils. Current slash-and-burn agricultural practices release carbon into the atmosphere, negatively affecting the local ecosystems and the global environment. However, terra preta soils appear

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to sequester carbon in the soil for long periods. Developing techniques to expand terra preta soils would benefit local farmers and could play an important role in the global carbon cycle.

— *Linda Kincaid*

Active in CRFG since 1988, Linda Kincaid has been an avid gardener for 20 years and an organic gardener for the last 15. E-mail: lindakincaid@yahoo.com.

Fruit Gardener: A2886.

[http://www.newfarm.org/news/041803/drdon_soil_p3.shtml]

Tropical soil fertility and Terra Preta soils of the Amazon

Deep in the Brazilian Amazon, where formerly forested land has given way to cultivation and grazing on low-fertility Oxisols and similar ultra-weathered soils, there are scattered patches of land whose colour is not red, as Oxisols are, but dark and black.

These are known as known as Terra Preta soils. It has been known for some time that Terra Preta soils are far more fertile than nearby soils, but only recently have scientists begun to seriously consider why. It has been determined that no geological phenomena are responsible for the Terra Preta soils, that they are "anthropogenic" – man made.

The mystery component in Terra Preta soils was discovered to be charcoal. Apparently, pre-Columbian Indians from 500 to 2500 years BP cut the forest, and instead of burning it on top of the soil, leaving ashes and very little carbon, as in slash and burn agriculture, they buried the biomass and

burned it, as is done when making charcoal. The incomplete combustion of biomass, due to lack of oxygen, leaves charcoal.

The surprising thing is that, some 1500 years later, these soils are still fertile, and preferred by local farmers! The average size of the Terra Preta areas is 20 ha.

Cornell University researcher Johannes Lehmann has done research on Terra Preta soils and found higher cation exchange capacity, carbon, nitrogen, phosphorus, and potassium than surrounding red soils. The charcoal form of carbon is much more stable in soils than the average microbially released carbon, except for perhaps the most stable forms of humus. When humic acid derived from coal deposits were applied to soils, similar results to Terra Preta soils were obtained. The next area of research in Terra Preta and charcoalized soils is to determine the microbial dynamics.

— *Don Lotter*

[http://www.css.cornell.edu/faculty/lehmann/terra_preta/TerraPretahome.htm]

Terra Preta de Indio — Soil biogeochemistry

"Terra Preta de Indio" (Amazonian Dark Earths) is the local name for certain dark earths in the Brazilian Amazon region. These dark earths occur, however, in several countries in South America and probably beyond. They were most likely created by pre-Columbian Indians from 500 to 2500 years BP and abandoned after the invasion of Europeans. However, many questions are still unanswered with respect to their origin,

distribution, and properties.

The origin of Amazonian dark earths

Already at the end of the 19th century, Smith and Hartt reported the existence of dark earths in the Amazon, which had a dark colour and were highly fertile. The origin of the Amazonian dark earths is not entirely clear and several conflicting theories were discussed in the past. Camargo speculated that these soils might have formed on fallout from volcanoes in the Andes, since they were only found on the highest spots in the landscape.

Other theories included a formation as a result of sedimentation in Tertiary lakes or in recent ponds. Further theories are mentioned by Smith, which all did not hold against later investigations.

It is now widely accepted that these soils were not only used by the local population but are a product of indigenous soil management.

Later surveys confirmed these findings. Whether they were intentionally created for soil improvement or whether they are a by-product of habitation is not clear at present. This is in part due to the varied features of the dark earths throughout the Amazon basin.

Amazonian Dark Earths and the global climate

The global carbon cycle has been brought to wide attention due to its importance for the global climate. The Intergovernmental Panel on Global Change (IPCC) recently confirmed that the anthropogenic greenhouse effect is a reality, which we have to deal with in the future. The atmospheric CO₂ has increased from 280 ppm in 1750 to 367 ppm in 1999 and today's CO₂ concentrations have not been exceeded during the past 420,000 years.

The release or sequestration of carbon in soils is therefore of prime importance. Soil

Second Australian New Crops Conference

**Australian
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organic carbon is an important pool of carbon in the global biogeochemical cycle. The total amount of organic carbon in soils is estimated to be 2011 Gt C, which constitutes about 82% of the global organic carbon in terrestrial ecosystems.

About one third of this organic carbon is found in soils of the tropics, being half of the terrestrial organic carbon in tropical forest ecosystems. Tropical soils represent, therefore, an important pool of the terrestrial carbon reserves and thus the transformation and mode of stabilization of organic carbon in soils plays an important role in the global carbon cycle.

Amazonian dark earths have high carbon contents of up to 150 g C/kg soil in comparison to the surrounding soils with 20-30 g C/kg soil. Additionally, the horizons which are enriched in organic matter, are not only 10-20 cm deep as in surrounding soils, but may be as deep as 1 m (average values probably around 40-50 cm)!

Therefore, the total carbon stored in these soils can be one order of magnitude higher than in adjacent soils. Furthermore, the organic matter in the dark earths is persistent since we find these elevated carbon contents even hundreds of years after they were abandoned.

The reason for the high stability of the soil carbon is currently under discussion. So-called black carbon was identified as a probable reason for the high stability. Further research is necessary to quantify the recalcitrance of the soil carbon over long periods of time and determining techniques for creating such soils.

The structural similarity to charcoal led the authors to assume that accumulation or purposeful application of organic carbon from incomplete combustion may have been the primary reason for the high carbon contents

and fertility of these soils. That they were actually created by charcoal applications has still to be demonstrated.

Amazonian Dark Earths — implications for soil fertility and land use

In addition to their high soil organic matter contents as mentioned above, Amazonian dark earths are characterized by high P contents reaching 200-400 mg P/kg, and higher cation exchange capacity, pH and base saturation than surrounding soils.

These soils are therefore highly fertile. Fallows on the Amazonian dark earths can be as short as 6 months, whereas fallow periods on Oxisols are usually 8 to 10 years long. Only short fallows are presumed to be necessary for restoring fertility on the dark earths. However, precise information is not available, since farmers frequently fallow the land due to an overwhelming weed infestation and not due to declining soil fertility.

Continuous cropping for longer periods of time appears to be possible from a soil fertility point of view. How long a field can be continuously cropped and what can be done to prolong this period is not yet clear. Petersen reported that Amazonian dark earths in Açutuba were under continuous cultivation without fertilization for over 40 years.

Recent efforts stimulated by Terra Preta research included the investigation of incompletely combusted organic matter as a soil amendment to enhance nutrient availability and retention. Charcoal amendments were shown to significantly decrease nutrient leaching and increase crop growth, and the tests of slash-and-char systems were suggested as an alternative to slash-and-burn.

— *Johannes Lehmann*

[Irrigation & Water Resources / 2004 Win]

Peaches in the desert

Twenty kilometres west of the goldmining town of Cue, WA, and 360 km inland from Kalbarri on the west coast, Austin Downs might seem an unlikely location for a peach orchard.

The annual average rainfall is 210 millimetres, most of which falls during the winter, but the area is prone to cycles of plenty, followed by extremely dry periods.

Tom and Barbara Jackson, their daughter Jo and son Kynan and partners Martin and Amanda, came to the area three years ago in search of an alternative to farming.

"We were specifically interested in horticulture," Barbara said, "so when Austin Downs was advertised with a special irrigation lease included, it seemed right for us."

They didn't count on a string of obstacles being placed on their chosen path, however. Kynan said the basic problems they encountered were with bureaucratic processes.

"We needed to change the lease from being for the purpose of fodder production to horticulture. This required several bureaucrats to sign off on the variation. The most problematic was native title and national

competition policy".

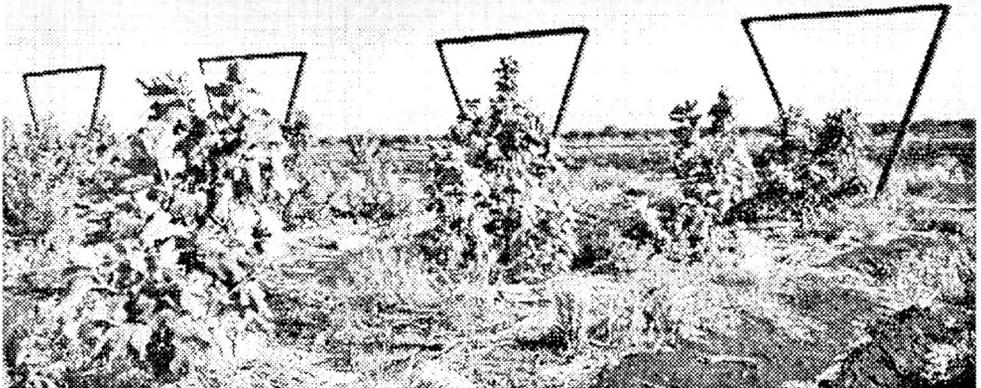
Although the irrigation lease had been used to grow fodder, the infrastructure had fallen into disrepair. Nevertheless, water supply was plentiful and the soil fertile.

One of the challenges faced by the Jacksons was the high salt content of the bore water on the lease — 1200 parts per million total salts. Experts in WA told them they would never be able to grow peaches with such water, but they persevered and went further afield for advice.

After extensive research into irrigation methods in South Australia's Riverland, the family planted 2000 peach trees sourced from Queensland and Manjimup, WA. They chose two varieties— UF Gold and Tropical Snow. Both have the advantages of fruiting early and being suited to the warmer northern climate.

The original fodder plots had been flood irrigated, an outdated and wasteful method according to Kynan. Now each row is mounded and reticulated with 32 mm black poly drilled at one-metre intervals to allow low-pressure seepage to each plant.

Hay back-loaded from Perth when fruit is transported to markets, and therefore economical to buy, is spread along the rows as mulch about 100 mm thick. This reduces evaporation, allowing the salt to soak deep



Peaches growing on Open Tatura trellis near Cue, Western Australia

into the soil away from the roots. The banks deepen the soil. The trees are given more water than they need, and are periodically flooded to flush away any salt build-up. The trees are grown on Open Tatura trellises.

Last season, 100 Tropical Snow trees yielded 400 trays of quality fruit (30 peaches to a tray). Kynan admits the orchard is high-maintenance, but believes the returns are there.

"We have a reliable market in Perth that will take all we can produce," he said. "Our peaches are high in sugar because of the warm climate and amount of winter sunlight we get up here. I also believe the salty water improves the flavour, although there is no research to back this up."

To access high-value, early stone fruit markets, the Jacksons artificially altered the cycle of the peach trees, using copper and zinc sprays to induce dormancy. The trees are 'put to sleep' in the first week of May, 'woken up' in June with a severe pruning, blossom in July and the fruit is harvested in November.

Last summer's crop brought \$18/tray in Perth. The Jacksons plan to bring the fruit cycle still further forward this year to harvest in October and capture a higher premium. Their target for 2004-2005 is \$23/tray.

With only a fraction of the special lease under irrigation so far, there is huge potential for expansion.

Chinese Date or Zizyphus

"We're always looking at new varieties to see what will grow here," Kynan said. "One pretty exciting possibility is the Chinese date, or zizyphus. We have 1000 plants in at the moment. It's reported to have health benefits as a skin moisturizer and anti-cancer agent. I'm currently doing some research on that with the help of a Federal Government scholarship."

So far, insect pests have not been a problem



Kynan and Amanda Jackson use heavy mulching and drip irrigation to conserve water while producing quality fruit

apart from an infestation of pasture loper, which attacked the zizyphus but not the peaches. The orchard's remote location probably protects it in this respect.

Pumpkins, melons, herbs, root vegetables, figs and citrus also grow in neat rows alongside the trellised peach trees. Olive trees line the perimeter of the lease, acting as a wind break which will also produce a cash crop in the future.

— *Kathy Baladeras*

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CALENDAR OF FORTHCOMING EVENTS

Deadline for next issue: Oct 10, 2004

2004

- Aug 19 Thu * Wanatca General Meeting (David Kennett - The Kennet Tree Planting System)
- Aug 24-26 • Dowerin Agricultural Field Days
- Sep 18 Sat • Karragullen Horticultural Field Day
- Sep 20-24 §Acotanc-2004, Gatton, Queensland
(www.newcrops.uq.edu.au/nc2004)
- Oct 5 Tue Wanatca Executive Committee Meeting
- Nov 16 Tue * Wanatca General Meeting (Jim Dawson - All About Jujubes)

*General Meetings are held starting at 7.30pm. Venue: As noted in each case.

These meetings usual'y include a display of current world tree-crop magazines offered free.

• Event with WANATCA participation; § Refer to news item in this issue of *Quandong*.

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