

Citrus Study Tour to South Africa

Stephen Burdette
AgriExchange Pty Ltd

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Level 1

50 Carrington Street

Sydney NSW 2000

Telephone: (02) 8295 2300

Fax: (02) 8295 2399

E-Mail: horticulture@horticulture.com.au

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CITRUS STUDY TOUR TO SOUTH AFRICA: 9-23 AUGUST 2006

PROJECT NUMBER: CTO5014 (15 November 2006)

Project Leader:

Steve Burdette, Business Development Manager, Yandilla Park Pty Ltd.

Tour members:

Philip Binder, Production Manager, Yandilla Park Agribusiness; Rosemary Manger, Citrus Project Manager, SAITEYSMcMahon;

Pamela Strange, Technical and Compliance Manager, Timbercorp Limited





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1. Media Summary

The **South African citrus industry** is expected to become a greater competitive threat to Australia in global export markets in future due to the projected growth in production from 78m to 120m x 15 kg carton equivalents between 2005 and 2020. The main crop increase is in navel and lemon production. The volume distribution includes 64% export, 17% domestic, 19% processed and revenue, 86% export, 12% domestic and 2% processed. Expansion into Asia and the Middle East is therefore a key priority for South African producers.

Research and Development (R&D) is grower funded and structured to gain access to all available expertise in the country (research institutions, universities, etc). The primary focus is on applied and basic research, technical extension, improved cultivar and rootstock options and market access. Australian expenditure on citrus research is similar to South Africa (\$2.3m), however, with less commercial outcome. Australia's R & D strategy is lagging behind its competitors and requires urgent review. Succession planning should form part of this strategy.

Cultivar development is a business in South Africa and expanding rapidly. Citrogold, one of South Africa's leading variety commercialization companies, has commercialized 4,382 hectares of citrus in grower groups with 1264 hectares on order (refer table 1 below). The Nadorcott (Afourer) is the most widely planted late mandarin variety but cross-pollination is the greatest challenge. The Or is not recommended in dry arid conditions and is a lot more difficult to produce. The Mor has the greatest potential in Australia and must be compared with DPI seedless murcott selection 2. Seedless lemons have potential and can be used as a cross-pollination buffer. The days of planting new varieties freely with no tree and or production royalties are considered to be over. Australia must therefore become a player in the global variety development arena by commercializing industry owned varieties internationally.

A range of **pre-and post harvest R&D control measures, production and packhouse practices and protocols** have been identified for testing under Australian conditions and include:

- (i) Mating disruption and control methods of key pests and diseases in Australia; the use of beneficial predators for the control of aphids, mealy bug, soft scales, citrus thrips and mites.
- (ii) Crop load and fruit management strategies to improve fruit size, reduce the risk of peteca (lemons), the incidence of creasing and splitting and colour improvement.
- (iii) Production practices for a range of new mandarin, lemon and orange varieties currently in Australia.
- (iv) Twelve varieties have been identified for importation into Australia.
- (v) Fungicide resistance (FR) is a major concern globally and is rapidly on the increase. FR management in the field and in the packinghouse requires a lot more attention in Australia and guidelines have been identified for future implementation in a bid to reduce waste losses and save costs. The initiative by the Cold Chain Centre (Australian Logistics Assured) in Australia to introduce uniform field, packinghouse and shipping protocols deserves greater support from industry.

Greening disease has spread significantly in South Africa and is very costly to control. Australia must continue to enforce its strict phytosanitary policy to prevent Asian greening to spread to Australia.

Key outcomes: New production practices have been identified that will enable Australian citrus growers to be more competitive and cost effective in the long term.

Table 1: The current status licensed varieties commercialized in South Africa

Varieties	Trademark	Export cartons	Ha planted	Ha on order	Grand total
Nadorcott	Clemengold	2 million	853	525	1353
Orri (Or)	Clemenor	300 000	169	28	197
Mor	Honeygold	300 000	70	30	100
Clemenpons	None		123	131	254
Eureka seedless	Aziko	2.5 million	365	353	718
Primasole	None		2	42	44
Turkey	Juvalle	500 000	2800	155	2955
TOTAL		5.6 million cartons	4382 ha	1264 ha	5621 ha

2. Expected Outcomes

2.1 Aim: The aim of the trip is to study and gain information that growers' and packers can implement in a timely and practical way to address the challenges and threats of changing consumer demand, higher costs and competition from other countries. This is to ensure that improving and adopting world best practices on an ongoing basis retain the longevity of the Australian citrus industry.

2.2 Key issues to be addressed: The key issues to be addressed include:

- (i) Learning about the acceptance and implementation of logistical and marketing protocols of new varieties from countries currently supplying these varieties;
- (ii) Identifying the preferred seedless easy peeler varieties early and late in the season as well as improved internal and external quality characteristics of early and late season orange, grapefruit and lemon types;
- (iii) Assessing general production techniques and costs of competitors for benchmarking and adoption.

2.3 Benefits to the industry: The intended outcomes of the tour can be summarised as follows:

- (i) Expose leading citrus growers to new production practices and packinghouse technologies and ensure they are implemented so that the cost savings in productivity and efficiency can be measured;
- (ii) Establish local contacts to ensure collaboration on sharing of technical, packing, research and marketing information. The areas of collaboration and the process to be followed will be identified;

- (iii) Benchmarking production, packing and marketing costs to determine areas of possible cost saving. The strategies are to be listed and measured;
- (iv) Highlighting the most important R&D findings and ensuring production and packing protocols are amended and implemented.

3. Results of Discussions

3.1 Introduction

The Southern African citrus industry has one of the highest pest complexes in the world. Despite this the industry is very reliant on the export market and has expanded plantings with confidence. A challenge in the future is the projected growth in production in 2020.

*Production historic and expected – million cartons

	1995	2005	2020
Total	40 million	78 million	120 million
Valencia	33	43	43
Navel	14	21	30
Red G/fruit	9	10	9
Marsh G/fruit	5	4	2
Clementine	3	3.5	4.2
Satsuma	1	1.5	2.7
Mandarin	0.5	1.5	2.8
Lemon	7.5	11	18

* The following source of information was used: CGA tree census, Citrus Foundation Block (CFB) budwood sales, regional questionnaire, CRI crop load studies, Dux Business Solutions DB in packhouses and PPECB (AQIS) validation. Assumptions made include; yield was predicted, budwood sales would drop by 20% per annum, 15% budwood sales would not reach maturity, 10% of budwood sales were for replants, trees would be culled after 26-33yrs. **The crop prediction in 2010 is oranges-67 million x 15 kg cartons; soft citrus 8 million, lemons-10 million and grapefruit-15 million (total 100 million cartons).**

In comparison to the Australian citrus industry, the statistics can be compared as follows:

Item	South Africa	Australia
Hectares	56,000	32,000
World producer	12 th	27 th
World exporter	2 nd	13 th
No of growers	1400	2,800
Total tonnes	100 million	650,000

On average the tonnes per ha is 35, 8 and cartons 2386/ha. South Africa has 75 packhouses, 100 export agencies, of which 10 market 90% of the volume.

Volume distribution = 64% export, local 17%, processed 19%.

Revenue = 86% export, local 12%, processed 2%.

Approximately 50% of the volume is shipped to the UK and Europe. Eurepgap is therefore an important part of the production process. An estimated 8% of the volume is exported to the USA, as False Codling Moth (FCM) and citrus black spot (CBS) are quarantine pests disallowed in the USA. All fruit must be cold treated for 24 days at minus 2°C. The Middle East/Far East is a growing market for South Africa (17%), as well as Russia (11%), and Japan (9%). China is an unknown factor at the moment, but there is a high reliance on this market as well as Iran to move the increased volumes in future.

The competitiveness of the Southern African citrus industry is continuously challenged and the key issues identified include:

- Product quality, quality, quality, quality. Good quality always sells.
- Differentiation can either achieved by being more cost competitive or by product differentiation or both. RSA achieves a higher price (18-38% more) than Argentina because of the perceived better quality but this quality image is slipping. Drivers of good quality include research, extension, training, good agricultural practice (GAP), packhouse practices, packaging, regulatory standards, effective policing of the standards, transport and storage.
- New Product Development, e.g. Spain has a huge range of citrus products that span from early September to end May and they are continuously looking for more varieties (late Navels & Clementine's) to extend the marketing window further.
- Market Access Choices: Huge choices are now available, i.e. EU is down from 75% (1970) to 50% (2005) and the Middle East has become more important. Key drivers for this include government capacity, research, champions and lobbying (politics).
- Trade Barriers such as traditional, sanitary and phytosanitary (pest & disease) barriers. The drivers include government capacity, research, extension, training and lobbying.
- Human capital, strong leadership; training skills development e.g. Citrus Growers Association promoting citrus academy.
- Information: after deregulation there was a loss of information, but the industry is now trying to build that back up again through training and succession planning.
- Infrastructure: road, rail, ports
- Promotion: brand versus generic: trade fairs & promotional material.
- Administration: the costs of doing business.
- Stability: economic and political
- HIV Aids is affecting productivity and staff turnover and has social effects.
- Wild Card: the price of fuel

3.2 Research and Development

After deregulation of the citrus industry in 1998, the Research and Technical (R&T) Division was restructured to gain access to all available expertise in the country, including Universities, Research institutions etc. One of the challenges that the industry

has encountered has been the loss of expertise and the 10 to 15 year gap that has been created in training new researchers. The second challenge is to ensure that they focus on all industry priorities. The sustainability of funding is split between levies and commercialisation of Intellectual Property (represents 40% of the income), such as the SIT (sterile insect technique) used to control False Codling Moth, the M3 Fruit Fly Baiting Station, NPV for bollworm and various contract work.

Citrus Research International (CRI) is the main R&D body in South Africa. The CRI board is made up of 2 x University representatives (University of Pretoria and Stellenbosch), 6 x Grower representatives (one from each region), 1 x Research Council, 1 x Export Agent and 1 x Consultant. The Chairman of the CRI Board is Dr Jock Dankwaerts and the CEO Dr Vaughan Hattingh. The CRI is grower funded to provide Southern African growers' with applied and basic research results, technical extension and to improve cultivar and rootstock options. The total amount of grower levies allocated to research and technology transfer (excluding the Citrus Improvement Programme, training, infrastructure and overheads) in the 2006/07 financial years is R11, 9 million (AUD \$2.3 million). Citrus Research International utilises 77% of the funds and other contractors such as Universities 33%. The funds are allocated as follows:

- Integrated crop management-R3.1 million (FCM-44%; FF-28%)
- Disease Management-R2.9 million (GTD-39%; CBS-20%; post harvest pathology-17%)
- Crop load and Fruit Quality Management-R1.2 million (rind quality-69%; fruit production-31%)
- Cultivar Development (66%) and Evaluation (34%)-R1.2 million
- Market Access and Technical Coordination-R 0.6 million
- Technology Transfer- R2.9 million

When the industry was regulated, the levy charged by Outspan was voluntary. Following deregulation of the citrus industry, Capespan charged a compulsory levy and after the formation of CRI in 2001, a compulsory levy of R0.31/15kg carton (AUD \$0.06/carton) was introduced. Government provides matching funds in some cases where the researchers are based at the Universities and lecturing is combined with research.

CRI prioritises R&D requirements by liaising with 25 individual Grower Groups (similar to the Australian Cirtgroup concept) to identify research priorities for the region. One of the aims of the CRI is to ensure that the first priority from each group or region is researched each year. CRI call for Research Proposals. Each grower (big and small) has equal say in the priorities. Grower representatives vet the proposals and the CRI Board approves all Research on behalf of the industry. Some CRI Researchers are based at the Universities, where more basic research is undertaken. The main focus areas of the CRI is summarised as follows:

(i) Research (Dr Tim Grout)

IPM- Bio-control disruption

Cosmetic pests

False codling moth

Fruit flies, including Med fly

Mealy bugs and other Phytosanitary pests

Production pests

Disease Management- Soil borne diseases & nematodes

Graft transmissible diseases

Citrus Black Spot

Fruit & Foliar diseases including alternaria on soft citrus

Post harvest pathology.

*Crop Load and Fruit Quality Management- Fruit production and Quality (irrigation, sunburn, internal quality)

Rind condition

* Two new scientists have been appointed recently, viz. (i) Stephan Verryne – completed his PhD in California working with Carol Lovett. His expertise is pre-harvest horticulture focusing on crop load, fruit size and creasing; (ii) Paul Cronje – Completing his PhD at the University of Stellenbosch under Graham Barry, and is responsible for post –harvest research in horticulture and focuses on rind condition, peteca, rind pitting and pre-cooling.

(ii) Market Access (Dr Vaughan Hattingh)

(iii) Extension – (Dr Hennie le Roux)

-Grower Group (Cittgroups like Aust)

-Nursery Accreditation Scheme

(iv) Cultivar Development Program (Dr Graham Barry – supported by the Citrus Foundation Block-Mr Thys du Toit): Cultivars; Rootstocks; Evaluations; Acquisitions.

Disease management and IPM are the 2 biggest research areas. The Citrus Improvement Program pays for itself through budwood and seed sales. The majority of research is done on grower's properties. Research is extended at a Symposium held every 2nd years, and articles are published in SA Fruit Journals. Grower days are also a popular means of transferring technology.

It is quite clear that CRI will not enter into any formal R & D agreement with any country if it is in conflict with their local growers. Any cooperation will have to be done on an individual basis, and will preferably be done at a basic research level.

It was interesting to note that the RSA is also experiencing problems with students willing to study horticulture (viticulture is more popular). Graduates are also reluctant to move to a rural area such as Nelspruit, where there is the greatest need.

3.3 Market Access

The Southern African citrus industry faces great challenges with the projected increase in production if existing markets are not retained and new markets developed, as the industry is export reliant. Consequently the GRO Principle, (Gaining, Retaining & Optimising,) has been rated as a key industry priority. The allocation of resources to this project is as follows: (i) Gaining or opening new markets = 20%; (ii) Retaining existing markets with ongoing resources = 50%; (iii) Optimising ongoing opportunities to improve terms and scope of access to existing markets = 30%. The Marketing

Access Process can be very cumbersome to gain access to new markets. Some form of inter-state co-operative agreement is required and Bilateral agreements between trading partners is part of the process such as including pest and disease lists, pest risk analysis, risk mitigation of the importing country, legislation, export protocols, etc. This may take 6 – 10 – 20 years before trade can commence. Key considerations in this process include, inter government relations, market opportunities/ constraints and industry production, i.e. logistical and organisational status.

The status of market access to major export markets in South Africa is as follows:

(i) The **EU** absorbs 50% of the export volume from SA; the main issues are CBS (citrus black spot), FCM (false codling moth), residues, and non-Mediterranean Fruit flies. SA relies heavily on pre-harvest practices for these pests.

(ii) **Japan**; CBS, fruit flies (cold treatment), FCM and residues; use of pre and post harvest practices are restricting factors. Opportunities exist for access for Clementine's but optimum cold treatment conditions will apply.

(iii) **USA** is a small volume market but strategically important, especially for Clementine's. Issues include FCM, CBS (Northern Cape), hitchhikers (grain chinch bug), and FCM (duration of cold treatment).

(iv) **China**; FCM, GAP's, protocol conditions and other pests including carob moth, FRW, fruit flies, etc. remain a challenge. The protocol to China has been revised, and RSA will be allowed to cold sterilise fruit at –0.5 degrees C for 22 days. Consequently, the number of farms registered has increased from 7 to 400.

(v) **South Korea**; FCM and mealy bugs pose the greatest threat. Opportunities have been identified for lemons and grapefruit.

(vi) **New Market opportunities** into Iran, India, Australia, Israel (lemons), Jordan, Lebanon, Syria, Thailand, also need to be considered.

3.4 Citrus Improvement Programme (CIP)

South African citrus industry has 22 registered nurseries that comply with nursery accreditation standards. These accredited nurseries have formed the South African Nurseryman's Association. Ngama Munduku of Du Roi Nursery has just been voted Chairman of this Association. Five of these nurseries produce 80% of trees, with Du Roi sourcing 45% of the propagation material produced by the Citrus Foundation Block (CFB). New legislation is being introduced to ensure all private and commercial nurseries use certified propagation material produced by the CFB.

Citrus Improvement Programme (CIP) staff audit the accreditation of the certified nurseries twice per year. Soil samples are taken and analysed 4 times per year for *Phytophthora*, *Pythium*, and once per year for nematodes. Water is tested 4 times per year, using 'Spore-traps'. Each Nursery is given a confidential rating by the CIP. During the audit process, the following is reviewed: Accreditation certification; security of the facility; drainage load and disposal; rainwater load and disposal; media pathogen status; placement of pots in contamination free position; TQM system; traceability system – including budwood coding; tree status and condition; height of bud union above the soil – usually 200mm; no root benching; 80% of the trees in the Nursery must meet 'Industry standards'; administration; tree / budwood register.

Nurseries must obtain propagation material from the CFB. The CFB supplies budwood all year round except May – July (winter) and nurseries bud all year, especially in the warmer production regions. Budwood orders are placed by Wednesday, cut Thursday

and sent by courier on Friday. Budwood is cut in 25cm length, treated with Captan and Benlate, placed in a plastic bag and dried before closing, pre-cooled and then couriered to the nursery. In the event that budwood has PBR rights, the growers must first obtain a contract with the owner of the PBR material before ordering the trees from the Nursery. The Nursery uses this contract as a reference for the order of budwood. Budwood is supplied at R0.45 per bud (Royalties are collected by the PBR owner).

Seed is harvested in June, treated with 'Chino Salt' – 8,Hydroxy-Quinolene Sulphate, surface dried and placed in 1 and 2 litre bags and stored at 10 degrees C. Seed cost R550/L for all varieties. Each batch of budwood and seed that the Improvement Program supplies are certified pathogen free and true to type. The grower applies to the CIP for a plant certificate after collection of the trees from the Nursery. There is a charge of R30 per certificate.

If budwood is not available then nurserymen can cut buds under supervision from daughter trees in the nursery that originate from CFB budwood, however these trees must be kept in a greenhouse totally isolated from the trees budded from the Certification scheme. An example of the multiplication rate at the CFB is Mor 26, 50 buds to 30,000 buds in 8 months.

CFB trees are planted in 10L containers in insect proof houses. There are 6 trees of each variety, on various rootstocks and they are renewed every 5 years. Twice per year the trees are evaluated for trueness to type. There are 3 cycles per year per tree and 30 buds can be cut per cycle i.e. 90 buds per cycle. They expect a 90% take with the budwood. Buds cost R0.45 per bud (excluding royalties).



Parent trees at the Citrus Foundation Block

Time schedule for Shoot Tip Grafting (STG) and inclusion of citrus material in the CIP.

Day 1	Buds received and budded to virus-free rootstocks. When bud sticks are in good condition they are also placed in vitro in the growth room.
90	Tender shoot tips taken for STG. Budded plants held in growth chamber
100	Small STG plants grafted onto large seedlings in glass house to force growth.
240	Indexing commences
330	Pre-immunization commences
420	Material declared citrus viroid and citrus tristeza virus free. Pre-immunized material tested for presence of mild isolate and released to the Citrus Foundation Block.
960	First evaluation at CFB.

Citrus Nursery Tree Size Standards

Minimum bud height 200mm

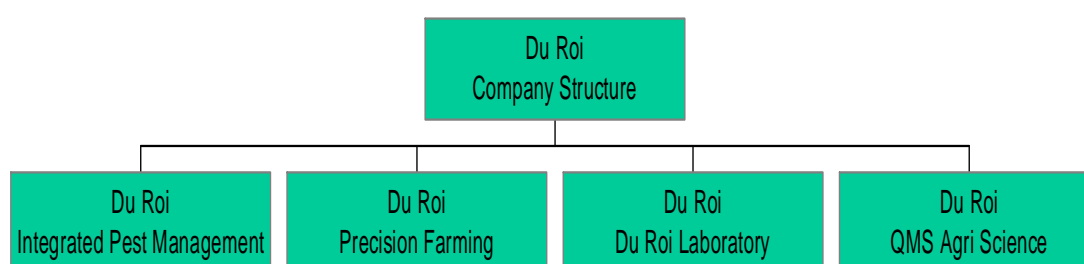
Category	Name	Description
1	Mini-tree	A tree showing bud (scion) growth of at least 15cm
2	Whip tree	A tree without any scaffold branches but with a stem (scion) already hardened off at the intended topping height. Trees may therefore be topped at any height

		above 15cm above the bud-union to suit the growers' requirements.
3	Scaffold tree	A tree which has formed scaffold branches at a height required by the grower, with a stem thick enough to support the scaffold.

Note that Category 1 trees are very small and require nursing in the orchard. All orders should be in writing stipulating the type and size of tree required. Other standards can also be stipulated.

3.5 Nursery Practices

Du Roi citrus nursery produces between 800,000 – 1 million trees per annum and is considered to be one of the most advanced nurseries in the world. The company also has other value adding companies as indicated in the structure below:



Seed is germinated in special trays in germination chambers and incandescent fluorescent (blue) lights are used 24 hrs per day. Du Roi expects 40-50% of all seed sown will be culled. Any seedlings with roots growing at an angle greater than 45 degrees are discarded along with off types. Seedlings are selected out of trays 3-4 times over a 3-month period. Seedlings are transplanted into 'speedling' trays and placed in tunnels where the temperature is maintained at between 14 – 27 degrees C by heating and or a wet wall. They are kept in tunnels for 3 months before being transferred to a hardening off area for a further 3 months. Up until this point the seedlings are held on a speculative basis, only going into bags when orders are placed. Hygiene is critical to the success of the process, and germination trays are drenched every third week with Ridomil, and the tunnels every 6 weeks with Ridomil and Captan. The nursery is tested monthly for phytophthora and pithium by QMS (see below). Once seedlings are hardened off they are planted into 4 litre bags in pine bark pre-enriched with lime. The pH level should not drop below 4.5 and EC not higher than 1.29 monitored on a monthly basis. A foliar application is also applied once every 6 months, however this is not considered essential, as fertigation is adequate. Less than 1% of all saleable trees are discarded. The cost of trees for the growers in northern areas is 14R/tree (AUD \$ 2.70-\$3.00).



A critical component for the success of the nursery is the after sales service. Du Roi issues a 2-page document on tree care with each consignment delivered to the customer. Each customer is then visited on or just after delivery of the trees. A video has also been produced explaining how to plant a tree. The focus is on nurturing relationships.

3.6 Cultivar Development

Cultivar Development features very prominently in South Africa and is approached in three ways:

3.6.1 Agricultural Research Council (ARC)

The ARC is the government research body and the Institute for Tropical and Subtropical Crops (ITSC) the largest regional centre based in Nelspruit in the Mpumalanga province. Industry support / funding for the various government breeding programs have diminished significantly. The main reason for this is that the ARC is not prepared to share their IP with industry bodies. Consequently there is a great deal of animosity between industry and Government bodies at present. Equally important is that the ARC is under immense pressure to conduct research aimed at the ‘second economy’ (previously disadvantaged persons). The Government has reviewed its attitude towards funding of R & D, and is in the process of reopening and expanding several Research stations in the country.

(a) ITSC

This research Institute focuses mainly on two key areas:

(i) Pest Management

South Africa has 3 quarantine mango fruit flies – Mediterranean, Natal and Marula. Mango weevil is also a phytosanitary pest that is treated with a series of different interventions to prevent or disrupt the life cycle of the weevil. Disruption starts in the orchard by applying ground hygiene and sanitation practices, as well as a chemical intervention just prior to the egg-laying period. Fenthion and pyrethroids have been used on the trees, as well as a 5% solution of Kaolin (Surround) for thrips and weevils. Bait spraying for fruit fly – protein and Malathion is applied to the windbreak trees and not to the fruit!

(ii) Cultivar Development

The ITSC breeding programme in Nelspruit and Addo (ARS) in the Eastern Cape has been faced with a number of challenges such as the withdrawal of industry funding for a number of horticultural crops and government pressure to focus on research for the second economy. After consulting consumers, retailers, marketers, packhouses, processors and producers they have adapted their strategy accordingly. The key objectives of the program are to produce horticulture superior plants, focus on the maturation period, breed for resistance and tolerance and select for specific traits. The ITSC applies conventional, mutation and biotechnology (tetraploids) breeding techniques. The ARS Citrus Breeding program has focussed on mandarins, niche market fruit (e.g. red blush in easy peelers), seedless easy peelers, skin quality and ripening time to expand the harvest window, all for cooler climates. Funding is gradually being cut by government and they are struggling to assess all the varieties / rootstock combinations in the program. This will continue to be a frustration.

At ARS in Addo, WH/B/2/36, B17, B24 and Eureka Seedless Lemon are considered to be the most successful varieties released from their breeding program. CitroGold is in the process of negotiating the commercial rights to all the cultivars released from the ARC program but this Agreement has yet to be finalised.

The 'Forcing House' is a netted, 0.25ha in area and houses 2,600 potted trees on a trellis to force scion apical dominance away from the rootstock, out of the juvenile stage to induce early fruiting. Laterals are removed to a maximum height and growth. This system was started in Israel.

Phase 1; spacing 1,000 to 1,500 trees/ha; trees are removed after 10 years; 22,000 selections have been established on 10 ha with the possibility that around 10 to 12 may be worth pursuing further. Phase 2: 10 trees are planted on 5 rootstocks; trees are removed after 3 fruiting seasons; 16 of the most promising selections have been screened for planting in 2006.

According to the ITSC, the Cultivar Development Program has benefited the South African industry as follows:

- Five new citrus cultivars contributed R 251 million (AUD \$48 m) between 1993 to 1997
- Standard cultivars generated R 2305 m (AUD \$443 m)
- On average the value added is 10.8%
- The total citrus research cost: R 5 m (AUD \$ 1 m)
- Return on Investment; 50:1

Cultivar Development is also undertaken on other product types such as Papayas, Pineapples, Guava, Passion fruit and Macadamias. All ITSC cultivars and rootstocks are patented and a tree and or carton royalty is charged for their intellectual property.

Information transfer to the growers is done via farmers' days, bulletins/publications, Radio and TV interviews and Study Group meetings.

3.6.2 CRI

Dr Graham Barry is responsible for Cultivar Development, including fruit quality manipulation, sugar and acid metabolism and colour enhancement. CRI views Cultivar Development as a strategic initiative in innovation for the citrus industry and the planned direction is as follows: **Vision:** Southern African citrus producers will have access to (i) new citrus cultivars at favourable terms and conditions, and (ii) meaningful cultivar-related information to enhance decision-making; **Mission:** To provide Southern African citrus producers with rapid access to new citrus cultivars and associated information to enhance global competitiveness. **Outcomes:**

- Analysis of consumer needs
- Current status of each cultivar group
- Timely sourcing of new cultivars with favourable terms and conditions
- Provide independent and objective information on all citrus cultivars
- Optimise stakeholder returns through cultivar specific commercialisation
- Advance South Africa as the leader in cultivar innovation
- Analysis of competitor production statistics

Cultivar innovation directly impacts on the major commercial priority of product differentiation, which, together with cost chain management, is critical to long-term sustainability. Cultivar evaluations are aimed at achieving three main principle purposes: describe a cultivar's characteristics; determine broad climatic suitability of a cultivar, and, ultimately to determine the commercial potential in the market. Of interest is that Dr. Barry is an advocate for having a number of commercial companies in control of Plant Breeders Rights in South Africa, including CRI for the following reasons: (i) Growers had to have access to varieties at reasonable rates and conditions; (ii) there is concern that companies may gain rights in order to suppress a variety that they had already developed; (iii) the approach to control hectare allocations promoted by other companies is a concern (this appears to be at odds with his philosophy that CRI, and in particular his area, should be seen as the 'independent umpire' for growers requiring "neutral advice" on the characteristics, strengths and weaknesses of a particular new cultivar and offering research solutions to technical problems).

In addition, varieties from the University of California such as the TDE varieties, Gold Nugget and the Tango (sterile Nardorcott) were discussed briefly. CRI has negotiated the testing rights to these varieties with the commercial license still to be determined.

3.6.3 Variety Commercialisation Companies

At present, there are 4 private companies, including CRI handling PBR varieties on behalf of Breeders. Of the two major cultivar commercialisation companies in South Africa, Citrogold and LGS (a USA linked company); Citrogold is by far the largest and most advanced. Only this company was visited at the time of the visit.

(a) Citrogold Pty (Ltd) specialises in the commercialisation of citrus, sub-tropicals and ornamentals. The international structure of Citrogold Holdings / Bio-Gold comprises 7 regions – USA, South America, Europe/ Mediterranean, Australasia, China, Near East (India and Pakistan) and South Africa.

- Each region will determine its own variety priorities according to regional needs
- Financial incentives will be introduced to find local improved varieties
- Incentives to speed up the process of testing and commercialisation world wide
- Uniform simultaneous world wide technical evaluation

- Sustainable worldwide commercialisation
- Creating coordinated market demand
- Meeting market demand

To achieve the above there is a need for market independence. This is achieved by having strong relationships with good marketers which is performance based. Exclusivity is not granted to any specific marketer. The risk and reward management strategy of commercialising any new variety must be agreed to between all parties concerned.

To date Citrogold has commercialised 4 382 hectares in grower groups in the RSA with 1264 hectares on order. The current status of plantings coordinated by Citrogold is summarised in the Media Summary in point 1 above.

(i) Mission Statement:

- Strengthen the position of growers of horticultural crops by providing IP that increases their negotiating strength, competitiveness and profitability
- Offer national and internal breeders of selected varieties and developers of horticultural IP, an experienced, innovative and trustworthy vehicle through which their IP can be commercialised on a national and international basis
- To bring innovative models and branding strategies to the world wide marketing of the fruit of these varieties

(ii) Current activities:

- Horticultural Intellectual Property management company
- Plant Breeders Rights (PBR) management
- Trademark registrations
- Coordination of quarantine, Shoot Tip Grafting (STG) and Citrus Foundation Block
- Procurement, evaluation and selection of new cultivars from breeding programs around the world
- Technical Management
- R and D of production and harvest and post-harvest protocols
- Management of exclusive grower's clubs
- Coordination of producers, packers and exporters in producing countries around the world
- Management of international varietal alliances

Citrogold has a panel of experts that they use on a consultancy basis such as pat Barkley in Australia and Ballie Wahl in South Africa, which includes elite panellists, Nursery partners and the Agricultural Research Council of RSA.

Citrogold is the preferred partner for the Agricultural Research Council of RSA.

(iii) Progression of the commercialisation of varieties and rootstocks:

- **Worldwide control**
 - Limit hectares
 - Charge % FOB royalty
 - Influence on market price
- **No control world-wide**
 - Tree price royalty

- Fixed value per hectare for the first 5 years
- Cannot influence the market price
- **Trademarks**
 - Quality specification
 - Voluntary participation
 - Access fee to trademark participation
 - Only the best varieties must be used
 - Global participation by entities who aspire to excellence
- **Tree prices**
 - Simple variety control



(iv) Global trends in variety management:

- Freehold varieties
- Per tree royalty
- Per carton royalty
- Up front carton royalty
- Leasing of trees
- Combination hectare, tree and carton royalty
- Grower groupings
- Inter-continental alliances
- Multi-national ownership, e.g. Delmonte Gold
- Supermarket ownership, e.g. Wal-Mart's Summer Range

(v) Grower's Clubs:

Citrogold manages various grower clubs, viz. Eureka TM Grower Club (seedless lemon), Redstar TM Association (Cara Cara navel), Juvalle TM Association (Turkey valencia) and the Prestige Mandarin Growers (Pty) Ltd (Nadorcott, Mor, Or). The latter club is of the greatest interest as it is structured differently to the rest and is a unique model.

- It is a grower driven model in conjunction with Citrogold.
- The number of hectares has been capped for each variety.

- Each variety carries a trademark.
- Not more than one service provider is appointed per retail chain.
- Promotions have focused on specific fruit characteristics, resulting in consumer demand for a specific product by name.

One of the problems with the Grower's Club has been certain growers' pulling in a different direction. It is therefore important to select the right growers to participate in such a club. The majority of growers recognise that consolidation of supply is very important to strengthen the selling power of the product they grow. It is important to be aligned with innovators that have a commercial focus and are business orientated.

3.7 Cultivar Characteristics

3.7.1 ARC: A summary of the most promising citrus cultivars and rootstocks produced by the ITSC can be summarised as follows:

Variety/ Rootstock	Characteristics
Selection WH/B/2/36	Open pollinated Miho Wase Satsuma seedling taken from seed adjacent to Nova & Novelty pollen sources; 2 weeks later maturing than Miho Wase and superior quality to Satsuma; easy to de-green; the fruit does not become puffy.
B17 Valley Gold	A very high quality mid maturing Ellendale x Robinson mandarin cross; trees are moderately spreading with small thorns but bearing wood tends to be thornless; fruit size is small to medium and shape similar to Clementine; peels reasonably easy; > than 3 seeds per fruit in solid block plantings; acidity is quite high; severe to mild splitting occurs in March, depending on rind thickness; alternate bearing may be a problem; considered to be an early Nadorcott option.
B24 African Sunset	A high quality mid/late maturing (mid July-mid August) Ellendale x Robinson mandarin cross with larger fruit size and low seed content; considered to be a good alternative to the Orri mandarin from Israel but is prone to biannual bearing; fruit shape is flat and sensitive to wing scarring; peels moderately easy; fruit splitting occurs in March/April; fruit from young trees are large, rinds coarse and prone to granulation. Patented.
M 37	Clementine x (Ellendale x Novelty) cross; fruit size is small to medium in size and shape round; peeling is difficult and messy; the variety is prone to alternaria and creasing.
Washington mutation	The Washington Mutant is a small tree with good size fruit. This will variety will be released in the near future. Further evaluation in Australia is suggested.
Eureka Seedless TM	A pollen sterile lemon that is totally seedless; 700 ha planted mainly in the Northern areas of the RSA; the fruit is elongated and suitable for markets such as Japan; production in warmer areas is lower than the standard Eureka lemon.



Eureka seedless fruit at Addo Research Station

3.7.2 Citrogold: New variety development will focus on seedlessness, pollen sterility, improved rind colour and flavour, early and late maturity and tolerance to cold sterilisation. It is likely that varieties will be genetically modified in the future to capture disease resistance and high productivity. Variety and rootstock development issues experienced in South Africa include the following:

Cultivar group	Variety	Comment
1. Clementines	Primosole	A Miho Wase satsuma x Carvalhais hybrid; Leaf stress is a problem.
	Orogrande	An early maturing clementine with good external rind colour and eating quality; fruit set and size is a problem; reported to perform well

		in Patensie, Eastern Cape.
	Clemenpons	The sphero-blast/gall effect promotes early maturity; tree uniformity is a problem.
	Clemencott	An irradiated, low seeded (0.6 seeds on average) Clementine x Murcott hybrid.
2. Mandarin hybrids	Nadorcott	Reverse pollination is the biggest problem; disturbance of the bee's pathway and the study of bees required; a selection that is 2 weeks earlier maturing has been selected.
	Mor	Mor 25 & 26 has an average of 1 to 5 seeds per fruit; Mor 26 has a ribbing problem that improves with age. Mor 22 has been planted in the RSA (3 to 4 seeds per fruit); Mor 25 is in Australia.
	Hadas	A seeded Ellendale selection but very late maturing
2. Grapefruit/ Pummelo hybrids	Flamingo	A low naringen, sweet tasting, pink variety
	Pommelo x Flamingo cross	Early developmental stage
	Henderson mutation	Pink selection
	Hudson x Chandler cross	Early developmental stage
	Orah x Chandler cross	Orange cross
	Sweet Sunrise	A Triumph grapefruit selection; honey yellow rind colour; very sweet flavour with a low naringen content; smaller fruit size (92-84 mm) than standard grapefruit; seedless. Patent pending.
	Pomelit	A pink, low seeded selection with excellent eating quality; suitability in the Northern Territory should be tested.
2. Navels	Fukumoto	Fruit maturity is earliest followed by Navelina & Letaba early; it is preferable to use a navel interstock. Fukumoto has large, round fruit, good colour and early maturity and worth further evaluation as an early Navel. Trees with an inter-stock are not showing the signs of rootstock sprouting that have become evident in the Riverland and other parts of the world on citrange rootstock; C 35 rootstock is a problem.
	Letaba Early	A good alternative to navelina; maturity similar but fruit size round.
	Glen Ora late	Late maturing (July/August in the Cape areas) with a small navel end; less prone to creasing; tree growth is vigorous in the early years and productive; fruit size ranges between 82 mm-

		73 mm. Patented.
	Witkrans	Late maturing (end July to end August in the Cape) with a round fruit shape; fruit size is large to medium; the navel end is small. Patented.
	Kirkwood Red	Deep internal red pigment; red external expression; low seeded; exceptional flavour. Patent pending.
3. Valencias	Turkey (Juvalle)	Early maturing (one month); good eating quality; high pack-outs; very productive with medium to large fruit size. Patented.
	Bennie (Alpha)	Large fruit size; segments a bit tough; early maturing; susceptible to rind pitting; compact growth habit; low seeded; less prone to insect and wind damage. Patented.
	Ruby Valencia	Developed for the juicing market; smaller tree; deep internal red colour; no external pigment; need to promote anthocyanins.
	Lawalle Late Valencia	Vigorous growth with large leaves and a prominent petiole; very productive with medium to large fruit size; very low seeded; late maturity. Patent pending.
	Mc Clean Seedless Valencia	Tree and fruit characteristics are typical for valencias; this variety offers an alternative to extend the seedless valencia range in South Africa. Patented.
4. Rootstocks	Various	A79-cleopatra mandarin x swingle citrumelo hybrid; 6211-cleopatra mandarin hybrid; Mc Carthy x trifoliata hybrid; A40-Volckameriana x trifoliata hybrid

3.7.3 Characteristics of leading citrus varieties produced in South Africa

(i) Nadorcott (Afourer): In 1964 seeds of Murcott tangor were planted at the INRA research station near the village of Afourer, Morocco. There was a variation in the seedling population, among which INRA-W21 was selected due to its ease of peeling and reddish rind colour when compared with Murcott. The person who discovered the variety was El Bachir Nadori and the name given to this variety was Nadorcott (Nadori x Murcott). The cultivar rights of Nadorcott mandarin belong to the Nadorcott Protection Company (NPC), Morocco. This company registered the Plant breeders Rights in the Economic Union (EU) and registered a Plant Patent (PP) in the USA. Citrogold in South Africa is the only company to have signed a formal agreement with the NPC and hold the Southern Hemisphere rights to the variety. In the meantime NPC has taken legal action against all growers in the EU with illegal plantings of Nadorcott. According to NPC settlement has been agreed to with the growers who have planted Nadorcott in the EU and are paying NPC a tree royalty of Euro 8.00 per tree. The plant patent in the USA stands until challenged by the license holders. NPC still have the option to challenge the plant patent at any time but they do not desire to do so. Domaines Agricoles in Morocco registered the tradename Afourer and they are the exclusive user

of this tradename in the EU. The use of the variety name Afourer in Australia is therefore illegal and should be referred to as the Nadorcott. Other companies around the world have also registered trade names for the Nadorcott such as Clemengold TM by Citrogold in South Africa, Delite by Mulholland in the USA, etc. The only companies that have permission from the Nadorcott protection Company to register a brand name are Citrogold and Domaines Agricoles

Nadorcott trees are vigorous with an upright growth habit reaching 2.5 m in height after two and a half years. As fruit sets and matures on bearing trees, the tree canopy opens up naturally creating a light friendly tree. Sour orange, Troyer citrange and Sacaton citrumelo are reported to be compatible rootstocks. Fruit size is larger than Clementine and Nova with about 20% of the fruit smaller than 58 mm diameter. Rind colour is excellent deep orange in colour, a distinguishing characteristic of the variety. Rind texture is generally smooth, particularly in coastal regions. Fruit shape is oblate and fruit splitting and creasing minimal. Ribbing at the stem end is severe, especially for fruit from cooler inland production regions. Eating quality is excellent at peak maturity that extends over a six-week period between mid June and mid September. No rind pitting has been observed. Oleo sensitivity is similar to other mandarin types. Susceptibility to post harvest breakdown is unknown. Delayed harvest results in puffiness but granulation is minimal.

Flowering and time and flowering intensity of Nadorcott is similar to that of clementine mandarins but not as protracted as Nules. Nadorcott has viable pollen and are strong pollinators. The ovules are fertile and very sensitive to cross-pollination, with seed occurring in fruit from trees as far as 3 km from Clementines and lemons. Nadorcott trees are very precocious, setting 5 kg/tree at 18 months and 20kg/tree after 30 months. Yields of 40 to 50 kg /tree are common on 5 to 8-year old trees and up to 100 kg per tree on large trees at 5 x 4 m spacing. Alternate bearing from 30 to 80 ton/ha can occur. The aim is to set 55 ton/ha. Notes on different climatic production areas can be summarised as follows:

- **Hot production area (Letsitele):** Du Roi has the oldest planting (planted January 2001) of Nadorcott on Carrizo citrange (7.5ha) spaced at 5 x 1.5m in South Africa. The following have been harvested, year 2 – 52 tonnes/ha, year 3 – 58 t/ha, year 4 – 48 t/ha and then in year 5 – 35 t/ha. The decline in production is attributed to the severe drought in the region, and the inability to provide sufficient water. The trees are girdled every year during the 'balloon' stage of blossom to achieve fruit set and reduce tree vigour. An alternative method to achieve fruit set is to apply 20ppm GA at 100% petal drop and 2 weeks later. After each flush the trees receive a foliar application. Winter-chlorosis appears to be more prevalent in the northern areas and on sandy soils. The harvest period in the north can be over 4 weeks. The trees are pruned directly after harvest and topped in late December/January. A point to note is that Moroccans suggested that the pollination distance is 1000m, but under RSA conditions, Du Roi suggests a distance of 3000m.
- **Intermediate production area (Burgersfort):** Inspected a 60-hectare Afourer (Nadorcott) orchard, planted in 2002- 2003. The orchard was mounded and the trees spaced 5m x 1.5m, (1300 trees/ha), however, the ideal spacing for this variety is considered to be 5m x 2m (1000 trees per ha) in this area. Rootstocks were mostly Swingle, Carrizo and X639. One dripper line with 0.75m spacing drippers watered the trees. Yields ranged between 40-45t/ha for the 2 year old trees and 45-50tha for the 3-year old trees. There was some variation in fruit size,



Three year old Nadorcott trees at Burgersfort

- **Cold production area (Cape):** The trees were planted in 2001 and spaced at 3.5 x 1.5m on a trellis. Production in 2006 was 65 t/ha, with no seeds and brix levels around 11.5%. In this area, maturity starts with Or, like Minneola, in July, followed by Afourer in late July/ early August then there is a small gap before Mor matures, in late August.

(ii) **Mor:** The Mor mandarin is an induced mutation of Murcott tangor from Israel and owned by the Citrus Marketing Board of Israel. Consequently the characteristics of Mor are similar to those of Murcott with the exception that the seed content of Mor (selection 26) is extremely low (0 to 2 seeds per fruit compared with 20 to 30 seeds per fruit in Murcott). In view of the low seed content, cultural practices of Mor should be adapted accordingly. Orchard layout is also important to avoid pollination and seediness. Mor trees are very vigorous with an upright growth habit reaching 4 m in height by year 8. Vegetative vigour needs to be controlled and managed from planting. The trees are therefore not very productive in the initial years of production and forcing young trees into production will be necessary. Fruit size is very good > 58 mm diameter. Fruit shape is oblate and rind colour deep orange. A high incidence of ribbing occurs at the stem end. This variety is prone to splitting (up to 30%) and creasing due to its thin rind. The fruit matures from mid August onwards but the harvest window is relatively short (4 weeks). Mor is susceptible to *Alternaria* brown spot but less so than Nova and Minneola tangelo. Mor is incompatible with Swingle citrumelo but compatible with Troyer/Carrizo/C-35 citrange. Vigorous rootstocks such as rough lemon and Volckameriana can also be used.

A grower in the Western Cape planted the Afourer, Or and Mor and receives high returns for all three varieties. The preference is to market and produce Or as although it is more difficult variety to produce, the taste is preferred in the market. The Afourer is the most prolific and the easiest to manage of the three. Mor is considered to have good fruit, but has not produced well to date. The Mor on X639 rootstock is planted on a trellis spaced at 3.5 x 1.5m (1900 trees/ha) – 10 hectares were planted in 2001. This orchard is on MOHT with drippers at 1.6 L/hour x 2 drippers/tree, however, the flow rate is considered too high for the heavy clay soils, and would have been better at 1.2 L/hour. The first crop is produced within 2 years, and the current production is 45t/ha (25kg/tree), with 75% packout. The fruit is basically low seeded (up to 3 seed/fruit), late maturing with prominent ridging on the skin, and a deep orange rind colour. In RSA the Mor is harvested after Afourer. Brix levels are around 16 -16.5. The Mor is expected to be a good variety in Australia, as Australian growers have a Murcott growing culture. The fact that this variety is low seeded and not seedless, is considered an advantage from a fruit set point of view. The girdling of trees annually until age 3 – 4 is a recommended practice. The fruit are sensitive to Alternaria.

The following was noted during field visits to Mor orchards. A Mor orchard in the Citrusdal area was top worked in 1999, with a combination of Cleopatra mandarin rootstock, inter-planted with trees on Troyer citrange (the majority of RSA Mor plantings are on these 2 rootstocks). Mor 22 fruit was at optimum fruit maturity and each fruit had on average, 3 – 4 seeds per fruit. The fruit is very ribbed, with obvious yellow stripes in May. The ribbing effect is less at peak maturity. The packing standards were re-written for this variety to allow for the ribbing. Of importance is that Mor 22 cannot be planted beside Clementine or Afourer. Alternaria is not a problem in this area as humidity is fairly low. No crop manipulation is required. Fruit size is good. Mor 25 & 26 has 1-1.5 seeds/fruit on average and is the recommended selection. This Mor selection can be planted beside other mandarins (it's about pollen and ovule sterility, and seeds of Mor 25 are sterile, whereas murcott is pollen fertile and can fertilise itself). Israel has Mor 15. It would be unwise to plant Mor as a whip tree unless a trellis was envisaged, as it is an upright growing tree with few lateral branches.



Mor on rough lemon had highest yields in trials in the USA. It is possible to use rough lemon rootstock, as the sugars in Mor are naturally high. Bill Castle in Florida, USA, has experimented with X639 and swingle citrumelo.

(iii) Orri (Or): Orri mandarin is an induced mutation of Orah mandarin (Temple x Dancy hybrid) from Israel and owned by the Citrus marketing Board of Israel. Or 4 is the superior selection. The status of plantings in Israel is as follows:

- The Orri is the most widely planted late maturing mandarin in Israel (1130 hectares). Plantings along coastal areas where temperatures during flowering and fruit set (20 to 22 mm in diameter) are not too high and the humidity not too low.
- A high sugar low acid fruit with a yellow rind colour.
- Prone to alternate bearing (a variance of 5 tons per ha in the “off-year” and 60 tons in the “on-year”) and comes into production in year 5 and in some cases as late as year 7. It is critical to limit and regulate the first set (40 to 45 tons per ha is expected in one year and 20 to 28 tons per ha the following year) to prevent the initiation of alternate bearing by overbearing as this will require the implementation of a series of control measures. Orri trees flower prolifically, usually white blossom quality in both off-and on-years.
- The ideal Israeli management situation is to manage the bearing habit, tree architecture, nutritional status and orchard layout, viz. 667 trees per hectare at 3x5m spacing; developing a free standing, closed vase tree with 4 to 7 leaders (secondary structural branches) which can be alternatively girdled in consecutive years, to balance the tree.
- The trees must be pruned in winter immediately after cropping by opening the tree on the cooler side of the tree (South West if the row direction is North South), foliage thinned out and the tree skirted. A maximum of 20% of the total leaf capacity is removed during this process. The pruning technique required is to remove scaffold and tertiary branches by cutting back to nodes or branching angles so as to avoid strong re-growth from heading-type cuts.
- Fruit set is difficult to predict (more accurate after February) as the variety “hides” its crop (relatively small and inconspicuous flowers). The variety sets external and internal fruit and requires good light management to improve fruit distribution throughout the canopy as well as fruit colour and delayed maturity of internal fruit. Orri is also prone to mild sunburn and wind scar.
- The variety is self-compatible and can set parthenocarpically. Consequently the variety is sensitive to fruit drop and must not be subject to stress during fruit set.
- This variety has the habit of producing thorny suckers in the centre of the tree and should either be removed early by summer pruning or bent down prematurely to induce fruiting.



The following production practices are suggested in South Africa:

- **Fruit set strategy:** Apply **cincturing** to the main stem above the bud union at full bloom on alternate side branches for the first two years (3 to 4 year old trees) to bring the trees into a bearing cycle and prevent excessive vegetative growth. Incomplete girdling in the form of a spiral cut two half moon or semi-circles cut on opposite sides of the tree can be used where insufficient scaffold branches have been developed (less aggressive). **Cincturing tips** include: girdle active trees only; avoid stressed trees-girdle a few days after irrigation; ensure phytophthora does not enter the girdling wound; avoid trees treated with trunk treatments; girdle trees large enough to carry 15 kg per tree or more; do not damage the xylem vessels; sterilise girdling tools with 10% sodium hyper chlorite. **Gibberellic acid**, even at high concentration of 50 ppm only has a marginal effect on improving fruit set. Two applications of GA application of 20 ppm combined with girdling are recommended at full bloom and at 80- to 100% petal fall. Application in early morning close to dew point temperature and early evening will ensure maximum coverage of immature ovaries. Weather patterns should be monitored and GA applied when warmer spring temperatures are likely to occur shortly after application.
- **Fruit size strategy:** Fruit set and fruit size potential must be assessed after natural fruit drop occurs to determine whether any fruit size treatments are required. The following is recommended to improve fruit size:

Product	Concentration	Rate per 100 l water	Fruit size (timing)
Corasil-E	100 ppm	200 ml	10-12 mm
Citrimax	100 ppm	200 ml	10-12 mm
Maxim	10 ppm	1 Pill	15-18 mm

- **Summer pruning:** This is an important tool to reduce tree vigour, improve light penetration into the tree and for thinning out fruit to prevent an on-year cycle. Pruning can take the form of suckering manipulations, twisting of the branches and the removal of excessive growth and should be done after natural fruit drop. Excessive upright growth must be removed from the centre of the tree. Light cuts can be used to thin out fruit and to improve leaf: fruit ratio. **Bending down** of strong one-year old water shoots is done to convert to bearing wood in the months of October to February. String is used to affect the bending and can be done over a two-year period. Excessive **irrigation** can induce chlorosis. Cold induced chlorosis disappears with the onset of summer. This variety is also extremely sensitive to leaf discoloration. Winter chlorosis on Carrizo citrange is more prominent than on rough lemon rootstock. Post-harvest **nutrition** is very important, especially foliar applications to boost tree reserves just after harvest and prior to initiation of reproductive buds. Slow release winter soil applications of organic based products are also advisable. Late maturing mandarins have a very short period to recover their carbohydrate reserve status after cropping.
- **General characteristics:** Orri has an oblate fruit shape that peels easily. Maturity starts from mid July and harvesting can be delayed for 10 weeks, however, after 4 to 6 weeks the acid drops rapidly. Orri is not susceptible to Alternaria brown rot. This variety shows delayed compatibility symptoms on Swingle citrumelo, produces poor fruit quality on Volckameriana, with C-35/Troyer/Carrizo considered excellent rootstocks; the fruit has low pollen viability but is not completely pollen sterile and is therefore not suitable as a buffer cultivar. A narrow buffer block is required to avoid excessive seed set;

Notes on orchard visits in South Africa can be summarised as follows: The trees were planted in the Western Cape in 2001 and spaced at 3.5 x 1.5m on a trellis. Tree shape has been described as looking like a Hakea hedge, if left unpruned. This mandarin has great eating quality but variable production. Orri has a thinner skin, is easier to peel and has better internal colour than Mor. Brix levels are around 12.5 -13. In 2006 yields were 45t/ha-lots of fruit, with predominately small fruit size. Or trees can be planted next to Mor, but neither variety should be planted near Afourer due to the risk of cross-pollination. Minneola Tangelos are also strong pollinators and will result in high seed content in Afourer. Orri should be considered more suitable for a coastal planting than desert.

(iv)Clemenpons: The Clemenpons is spontaneous bud mutation of Clementine mandarin and was discovered by the owner Mr Juan Pons in Spain in 1968. The characteristics of Clemenpons are similar to those of Nules mandarin with exception of the following:

- Fruit maturity is approximately 14 days earlier.
- Internal fruit quality is better than the early maturing Marisol Clementine selection but colour development later. De-greening is required following careful maturity indexing to ensure that the fruit is picked at the correct stage of colour break.
- The tree is less vigorous (50% dwarfed compared to Nules) with a compact growth habit (2.8 meter is reached in year 8). The tree develops stem galls that retards tree growth and influences size control and fruit quality. The galls

increase in size with tree age and must be managed by using stem paints or covers.

- Higher planted densities of 4.5 m x 1.75 m to 2 m are suggested. This variety is compatible with Troyer/Carrizo/ C-35 citrange rootstocks. A bud union crease develops on Carrizo citrange rootstock resulting in good fruit set and enhances fruit set and colour. Regulation of crop load is important to prevent overcropping, small fruit size and alternate bearing.
- Cropping should be considered in the fourth year after planting.

(v) Midnight: The ideal spacing under Riverland conditions is considered to be 5.5m x 2m. Tree and crop manipulation in cooler production areas such as the Riverland is not considered to be important.

(vi) Delta Valencia: The ideal spacing in Riverland conditions is considered to be 6m x 3m. Crop manipulation in the hotter regions such as Queensland, is considered to be important for this variety, and girdling is suggested in the early production years, and GA on more mature trees. Deltas on Benton citrange rootstock are drought resistant.

(vii) Eureka ![™] Seedless Lemon: This lemon selection was developed by the Agricultural Research Council-Institute for Tropical and Subtropical Crops (ARC-ITSC) in Messina, South Africa. This variety is sold under the registered trade name Eureka SL and the marketing coordinated by Citrogold (Pty) Ltd via a single-desk, multi-channel marketing system. The fruit is sold largely to the food services industry for supply to restaurants, cocktail bars, etc.

Due to pollen and ovule sterility that results in seedless characteristics, fruit of the first flowering in spring tends to abscise under moderate environmental stress (hot, dry conditions), with the second flowering providing a better set. It is therefore important to girdle the trees at full bloom, to ensure fruit set on young trees. In Addo, fruit set is good without manipulation (cool area). It is important to cut back on nitrogen as the rind colours very quickly after colour break. This variety is a lot more sensitive to endoxerosis induced by summer stress than the standard Eureka lemon. This variety is suitable for farmers who are familiar with handling lemons, but not advocated in areas where lemons have not previously been planted. This lemon selection is incompatible with most trifoliate hybrid rootstocks such as citrange and Swingle citrumelo.

3.8 Research developments and cultural practices

The following key Research developments and cultural practices were identified:

Research group	Research activity	Progress
Disease Management	Citrus Black Spot (CBS)	(i) A PCR-based detection method for CBS has been developed to identify the disease in the field and on the fruit. Results are available within a day. (ii) It is important to determine the Critical Infection Period (CIP)-Short spray intervals (21-23 days) with mancozeb result in better control than longer spray intervals (30-35 days). Strobilurine fungicides also performed

		well; Benomyl improved CBS control by 13%, despite resistance. New products such as Copstar & Cropflo Super in tank mixtures with trifloxystrobin gave good control; the alternation spray sequence A=Copper & B= mancozeb controlled CBS well (ABAB sequence); tank mixtures consisting of reduced rates of registered fungicides such as mancozeb, copper oxychloride, copper hydroxide in tank mixtures with Sporekill (100ml/hl water) sprayed at 18 day intervals resulted in excellent CBS control; the application of benzimidazole, mancozeb & oil (or Sporekill) in November followed by strobilurin, copper and spray oil (A+B: C+D sequence) in January shows great potential.
	False Codling Moth (FCM)	(i) A Sterile Insect Technique is being developed to release sterile moths commercially. (ii) Cryptogran has been used commercially to control FCM for two years and is compatible with a range of other products. Alternative FCM hosts in the field have been identified to assist with the control strategy. (iii) The Isomate FCM dispenser density requirement is 500/ha in November and 300/ha at the end of January.
Integrated Pest Management	Bollworm	HearNPV significantly reduced bollworm infestation, reduced fruit cull by 92% & increased yield by 50%.
	Thrips	Alternatives to abamectin plus oil were tested but the results inconclusive; resistant management strategies are required.
	Grain Chinch Bug	Xterminator 7.5 g/l has been registered as a post-harvest treatment on citrus.
	Green lacewing predator	This is a beneficial predator of aphids, mealy bugs, soft scales citrus thrips and mites. Chemicals that caused the highest mortality include Dursban WG at 64 g/hl, Meothrin EC at 50 ml/hl & Mesurol WP at 10 g/hl with sugar 200 g/hl.
Crop Load & Fruit Quality Management	GA3	(i) GA3 is available in 12.5gm sachets and applied in September/October for fruit set; December/January for creasing and April/May for rind quality (can delay harvest); (ii) Problems with fruit set with seedless varieties in some climates can be

		overcome with a combination of girdling and GA such as Eureka seedless and Star ruby grapefruit; (iii) Girdling is effective, but labour intensive, promotes phytophthora and can cause yellowing/die-back on varieties such as Nardorcotts; (iv) Bahianinha navel and Turkey Valencia suffer leaf and fruit drop, as well as branch die-back when treated with GA.
	Peteca	Peteca in lemons can be affected by: (i) pre-harvest water stress followed by high water availability; (ii) weather alternatively hot and cold, particularly long, hot dry followed by wet conditions and is more prevalent after cold wet conditions just prior to harvest; (iii) late pruning; late oil sprays and late application of Nitrogen; (iv) rough handling; over brushing in packinghouse; high temperatures in water dip or wax; high temperature during drying; wax type used can also have an effect such as 'heavy' citrus waxes of polyethylene & Carnauba with high solids greater than 18% of shellacs and wood rosin. SOPP foam curtains add to the problem; (v) early season fruit is more susceptible than late season fruit.
	Creasing	(i) This last season creasing has been a major problem resulting in losses of between 50 to 60 % in certain areas. The key factor in creasing appears to temperature and light prior to harvest. The % of creasing on the inside of the fruit is far greater than the creasing on the outside face Experiments to control creasing in navels with Retain in August at 38mg/l appear promising; (ii) other options include De-Crease', a micro-nutrient mix at 50mls/100 litres at petal fall and Goemar BN 86E at 250mls/100litres at petal fall, 2 weeks after petal fall and after natural fruit drop (Nov/Dec).
	Splitting	Application of 1% Calcium Nitrate 2 to 3 weeks after petal fall is an effective control measure.
	Colour Improvement	Regalis should be tested for color improvement at 4 grams/litre; the addition of 100g/ml ethepon should also be considered.

	Auxins	Potassium nitrate sprayed with auxins can cause dieback while excess auxins can result in granulation.
Post Harvest Handling	Fungicide Resistance Management	(i) Blue mould is less sensitive to imazalil and guazatine fungicides than Green mould; (ii) control strategies include: do not use the same fungicide for pre and post harvest; regularly sanitise the fruit washing system; prompt treatment of fruit after harvest; daily packhouse sanitation; remove immediately all waste fruit from the packinghouse; use of fungicide mixtures e.g. guazatine / imazalil have different modes of action; 'SporeKill' is active against sensitive and resistant spores; new fungicides to be tested 'Guaxalil' – Imazalil and Guazatine registration pending; 'Philibuster' – Imazalil / Pyrimethanil – 2007 registration; 'Imazalil' 500EC – double application. The use of Spore kill, Imazacure and Thiabendazole in Australian packinghouses requires investigation.
Accreditation Systems		An Integrated Crop Management Access System (ICMAS), which covers Safety, Legality and Accountability, has been developed; ICMAS consolidates all of the recognised standards into a one-stop electronic food safety information system that provides a standard interpretation and enables farmers' to self-assess against various standards, and to construct their own standards.
Fruit Foliar & Soil Borne Diseases	Nematodes & Phytophthora	A new Rugby formulation is being tested as well as a new liquid Mocap formulation. Nemacur EC + Rugby applied on 5/6, 5/8 & 5/10 showed promising results; 2 Nemacur + Rugby had the best result but the treatment is expensive (R7.00/AUD \$1.50/tree); Crop Guard applied November/December and February/March (3 weeks apart) showed promise.
	Alternaria Brown Spot	Summer rainfall areas-200g/100 hl copper oxychloride & copper hydroxide sprayed monthly (8 applications-September-April); 100g/100 hl copper fungicide + 100 ml/hl water Spore kill resulted in 98% exportable fruit. Winter rainfall-similar results with copper hydroxide and Spore kill at the

		same rates (7 applications monthly).
Graft transmissible diseases	Citrus Tristeza Virus (CTV)	CTV results in severe stem pitting, production tree life reduced, reduced yield and fruit size. There are a number of strains that occur as mixtures due to the transfer by aphids. STG trees can be re-infected by aphids, and this tendency is reduced by inoculation with a slight strain of CTV. Studies are currently taking place to find improved mild strains. The original was known as GFMS 12 – the current superior strains are GFMS 35 and 78.

Other cultural practices worth highlighting include:

- **Maxim'** is reported to cause gumming in the stylar end of grapefruit and gumming problems in navels. This was later confirmed to primarily be occurring in the Letsitele area and is aggravated by drought conditions. Maxim is more aggressive than Corasil E, and timing of application is critical. At least 30% of the fruit is thinned and fruit size is larger if Maxim is applied at the correct timing. Researchers feel that Corasil E (120 day withholding period) gives a better effect than Maxim (90 day withholding period). When Corasil and Maxim are sprayed together, mummified fruit can be the result. Maxim had not been found to improve fruit colour. Researchers do not agree that Maxim affects colour and that any effect is as a result of the younger (greener) fruit being thinned from the tree. Need to be cautious about using Maxim on any stressed fruit/trees. Peteca on lemons is usually correlated with a cold change in weather conditions. It is best to wait at least a week before harvesting the fruit.
- Graham Barry has new examples of **cincturing tools** and digital fruit measuring equipment.
- **SAP analysis:** According to three leading growers, Omni-Sap as it does not provide any optimal nutrition levels (no norms/standards provided/phenological as well as seasonal timing) from which management decisions can be made. Leaf analysis is more reliable at this stage.

3.9 Farming Practices

Citrus producers in Southern Africa currently face many challenges. Profits have declined to unprecedented levels due to falling prices, production cost increases and a strong rand. Priorities, activities and alignment of producers have had to change drastically. It is therefore important to understand where the present business will lead, where one wants it to be and what one needs to do to get there. A consultancy group has developed a planning tool to test the likely outcome of a range of decisions and to understand the sensitivities of the business to its key variables. This assessment is based on a rigorous technical and financial audit.

3.9.1 Mphumalanga

(i) Karino Co-op Packhouse (Nelspruit)

This Co-operative aims at being the cheapest packer in the area, and the best marketer. Growers receive technical support from the Co-op, but are not obliged to sell all of their fruit through the Co-op. The Co-op markets the majority of the fruit as well.

Greening disease almost wiped out the area in the early 1990's. Greening is a bacterial disease carried by a vector called citrus psylla. There is potentially a major threat to Australia from Papua New Guinea in the near future.

In the 1970's, the Co-op size was 1000 hectares producing 1million cartons per annum, but the introduction of Greening disease in the late 1980's-90's brought this down to 300 hectares and 200,000 cartons. By 2006, plantings recovered to 650 hectares and export volumes to 1.4-1.5 million cartons. Twenty-two growers make up the Co-op and all survived the re-plant process, which took 10 years to get back to full production. Systemic insecticides are used to control the pest. Application methods include a combination of stem injections and Confidor through the dripper. Pruning and removal of infected material/ trees manage the small amount of the disease still present. The cost of the stem injection is R2-3/ha/year. Confidor is R5/tree. Confidor at 9ml/L also controls thrips, leaf miner and other insect pests. Another major disease threat in the area is black spot.

Navels are not ideally suited to the region and comprise 10% of the volume for export early in the season. The bulk of the plantings are Valencia types (mid season), primarily Midnight and Delta. Midnight experiences a copper deficiency in young trees and has some dieback and gumming issues. Affected trees are treated with 2 x copper sprays of 150gms / litre of copper oxy-chloride however this can darken any blemishes on the fruit. Delta has had difficulties in controlling the Nitrogen on sandy soils. Benny Valencia has been tested in the area but found to be highly susceptible to oleo, with up to 50% of the fruit affected. Eureka Seedless has shown variable bearing and reasonable fruit set. The fruit is susceptible to drying (endoxerosis) and colours up very quickly after harvest once the fruit matures internally (pick green, and before other lemon varieties).

A 1% urea spray is used to promote fruit set. Maxim has a full permit in RSA for fruit sizing. Corasil E is also used (at 26mm stage). A wetter must be used with these sprays. Note that Maxim has caused some issue with Midknights and needs to be used cautiously.

Juice fruit oranges pay R500 / tonne, while grapefruit pays R700 / tonne. Packout – Midnight 75%, with other Valencia at 70% and Navels 74%.

3.9.2 Western Cape

(i) Stellenbosch-Welgevallen Experimental Farm

The trellising trial conducted at this Farm comprises satsumas and Clementine's with single wire and the 'Tatura' trellis. Spacing was 4m x 1.5m, with 1667 trees / hectare and 4m x 1.75m with 3,200 trees per hectare. Planting on trellis must be with whip trees, and the angle of the rootstock during planting should not be less than 45 degrees. The key to the trellising system is to fill the gap between the trees as quickly as possible and to slow down the tree growth and consequent size.

The trellis system is being recommended for satsumas and afourers with lemons being marginal and Clementine's and navels not recommended. The Tatura system is not being recommended. There has been little uptake of this technical information to date.

70 tonnes per hectare has been harvested from the trellis system, compared to 40 tonnes per hectare from the conventional system. The last 3 years have only been 48 tonnes per hectare average however 'greening' disease has infected a major part of the Farm.

(ii) Citrusdal

Citrusdal is a very old citrus producing area, going back 200yrs. It is a big N-S valley, with well-drained, acidic, sandy soils and with winter rainfall. This area is the most similar to Riverland. The southern valley farms receive 500-600mm rainfall while northern farms get 350mm. Water is biggest limitation, as the river is seasonal so they use on-farm storage. The summers are very hot (heatwaves of + 35 degrees C at fruit set), with cold wet winters but no frost-lowest temperatures of 2 degrees C. On 32 degree Latitude

Commercial citrus orchards were initially planted on Sour Orange rootstock but were forced to change to Rough Lemon due to the high susceptibility of Sour Orange to Citrus Tristeza Virus. Fruit size is generally not a problem in this district. The key market focus is the USA as this region and the North Western Cape are the only two areas allowed to export to the USA (black spot free). Water is biggest limitation and is allocated and metered from the river at high cost. On-farm dams supplement water during the summer months. The Citrusdal area exports 7M cartons, with the majority being Navels (1.3 million cartons).

ALG Boerdery, a family owned business, comprises 400 hectares and 24 varieties in total, starting early with Satsumas to late with Valencias. This region is known for tree longevity and on this farm some 100 year old WNO and 80 year old Valencia trees are still producing profitable crops. Drainage water is re-used with no salinity or quality problems.

- Fukumoto on rough lemon has been planted but the rootstock should have been Troyer citrange. The performance of Fukumoto in South Africa appears to be inconsistent. The Fukumoto selection imported by Auscitrus performs differently to the RSA selection.
- Nules planted 5m x 2m has averaged 80 tonnes per hectare – 2 sprays of 10ppm GA are applied between full bloom and full petal fall (80%).
- The ideal spacing for Midnight, irrespective of rootstock usage is 5.5m x 2m, as the trees are naturally smaller.
- Granulated fertilizer and sprinkler irrigation is used. New products are being tested, including Humic Acid at differing rates of 25 to 50 litres per hectare, for a total of around 100 litres per hectare per year. Apparently some farms in the valley were using up to 300 litres per hectare per season due to better uptake of Potassium levels and this in turn improves fruit size.
- Fulvic Acid is added to the weedicide to increase uptake and reduce active rates.
- Omni-Sap has been investigated, but rejected due to the lack of information / standards.

Mouton Citrus has a USA investor partner (Seald Sweet) as well as a black empowerment company. The company is a Producer, Packer & Shipper but does not own a packing shed. The packing is outsourced to Goedehoop Citrus Cooperative, but manage the quality control when the fruit is packed.

This enterprise consists of 420 hectares of citrus spread over 7 farms. A further 200 hectares will be planted in future. The 7 farms throughout the valley are located in different microclimates thereby spreading the fruit maturity and risk in the region. Casual workers earn R6/hour minimum guaranteed wage. Mouton encourages workers to earn more through 'piece rate'. On average workers earn R300-400per week while a tractor driver typically earns R300-450/week with free housing.

Tree spacing is generally 1,000trees/ha supported by an adapted Advanced Fertigation System (AFS) for their conditions. Mouton has bought up farms in the area yielding 30t/ha then, remodelled and improved using AFS to achieve 60t/ha. The cost to rejuvenate old farms is R20-30 000/ha. Key production practices include the following:

- Growing and monitoring tools;
 - Increase K with high fruit set for fruit size.
 - Use help lines.
 - Take fruit measurements on help lines weekly (500 fruit per orchard monthly).
 - Take weekly shoot measurements and stem diameter.
 - Use Enviroskan, Neutron probes and C-Probes to determine water requirements.
 - Use Leaf & Soil analysis results to determine nutrition requirements.
 - Assess crop load.
- -Apply Controlled Deficit Irrigation (advised by G. Barry) and AFS - orchards react very quickly to this practice (pulse 1hour on and 1hour off-. A total of 6 hours irrigation per day is typical.
 - Only Ammonium Nitrate is used as a liquid fertiliser
- Water use allocation is 12 MI/ha/annum (10MI is used on micro and 5 – 6MI on drip irrigation (2.3 or 1.8L/hr drippers are used- single lines on younger plantings or double dripper lines on older converted orchards. The AFP schedule is adapted for each variety.
- Prune 2 times per year for light penetration and improved picking efficiencies. Spacing of trees affects picking efficiency, too close is potentially less efficient. The ideal spacing for oranges is 2.5m x 5.5m, 727 trees/ha; lemons at 6x3; Clementine's at 5.5 x 3m, getting 70-75t/ha, prune after fruit set when the volume of fruit set is known.
- 60t/ha is considered the optimum yield (profitable at 40t/ha) to ensure yield, fruit size and quality is balanced with 70% export packout. R32 (Navels) - R40 (mandarins) /carton is break-even return.
- A great deal of emphasis is placed on the market outcome for a particular variety. The current variety mix comprises (i) Mandarins (mid March to end August): Satsumas, Clementine's, Novas, Minneola tangelos, Temples (Scarlet), Afourer, Mor, Or; (ii) Navels-40% (early June to mid September): Palmer Cara Cara, Barnfield, Cambria, Witkrans; (iii) Valencia's (early August to mid October): Turkey (early), Midnight & Delta; (iii) Lemons (May to July): There is an over production of lemons in the valley at present. Yields range between 70-90t/ha on average of which 70-90% is exported. In future the variety focus will be on Early Clementine's (60t/ha and large size), growing the Late Mandarin business, Summer Navels and then Valencia's.

- Other variety characteristics include: Nova is preferred in the USA; Cara Cara requires a red external rind colour to differentiate the product; Turkey Valencia is a good “gap filler”, has very high pack-outs and is achieving the highest return in the USA market (peaks at count 56); Or is early, has a tough skin; Mor has the best taste; Afourer has good colour; the Or is girdled to get set every year; it is not necessary to girdle the Afourer or Mor if fruit set is not a problem. GA will be applied if required; a 5lb (2.3kg) box of Afourers realises US \$5-\$5.50 per box in the USA.
- The key to success is based on facilitating investment; employing good quality staff; attention to detail; managing a commodity business; investment in niche varieties; monitoring the profit threshold per variety per block; focussing on competitive advantage; selecting winners.

3.9.3 Eastern Cape (Sundays River)

The Sundays River Valley is located 40 km from the sea and stretches from Addo to Kirkwood. It consists of 3 areas, Sundays River, Patensie and Kat River. The average rainfall is 250mm and spread across the 12 months. September – February can be up to 40 degrees C, with 30% humidity. In 2006 there was scattered rain in each month and no temperature spikes. Humidity was higher than normal and no creasing occurred, fruit set was good and yields were high.

The total Eastern Cape valley does 20 million x 15kg cartons, with Patensie packing 4M, Kat River 1.5M, Sundays River Citrus Cooperative 8M and other packers the balance. It was noted that Kat River is a cold area and gets frost (cannot plant late varieties) but the other two areas are frost-free.

UniFrutti / Dunbrody Estate comprises 450ha citrus divided into 3 management units (200ha, 170ha, and 130ha). The farm is drip irrigated using button drippers. Mature trees get 8 drippers, down to 6, and smaller trees 4 drippers. The initial practice was to use 4L/hr drippers, but has since converted to 2L/hr to reduce the depth of the wetted pattern. This enterprise is interested in Sustainable, Biological Farming and has been applying manure for the past 4 years under the dripper. Chicken manure was used initially but converted to cow manure as it lasts longer. The aim is to increase the biological activity and worm population in the soil. Tree spacing varies as follows: 6 x 3m for Navels (555trees/ha), Clementine's at 5.5 x 2.5m (727 trees/ha) and Lemons at 6.5m x 4m (385 trees per ha).

Major Pests include Mealy Bug, Red Scale and Thrips. Confidor is the main chemical and is applied via the irrigation system. The recommended rate is 9ml/tree but 3ml/tree has given good results (a generic Confidor is now available and the price reduced from R1500/L to R500/L). Red Scale is also treated with Summer Oil and Nemesis. Thrips are treated with Avomectin. Four sprays are applied from mid-October to early-January.

Fertilizer is also applied in limited amounts each week via the irrigation system as follows: September – October- high Nitrogen, little Phosphorous and Potassium and some trace elements; end-October to late December- low N and high K. The fertilizer is mixed into 5-10,000L tanks and then siphoned into

a 500L tank where it is diluted and injected into the main line. Up to two sprays of KNO₃ are applied as nutrient sprays one in August and a second in November if required (gut feeling). CaNO₃ is applied to Nova's for rind quality at mid-late blossom.

Storage dams have been built on the farm and reliable irrigation water is supplied to the farm via canals. The water is high in salts (80 mSe). Farmers have a water right of 9ML/ha of citrus, but Dunbrody uses 6.5ML/ha. The cost is R500/ha/year for this Water Right.

The company packs on averages 650 – 800,000 cartons/year broken up as follows:

(i) Lemons 200,000 cartons, harvested between March and August with some summer crop in September to October (98% Eureka). The Valley is noted for quality lemons, exported to Middle East, Far East and Japan. Sundays River Valley produces 50% of the total RSA lemon production of 7 million cartons of which the majority is exported. The future impact of Argentina's lemon production in Europe remains a concern.

(ii) Navels 130,000 cartons (40,000 of late Navels), harvested the end of April to the end of August. Varieties consist of Newhall, Palmer, Washington navel and some late varieties such as California Lane Late navel, Autumn Gold, Powell, Cambria and Barnfield. 80% of the trees are sprayed with 10 ppm GA at the end of December/early January to hang fruit for the late market at the end of August. It was noted that the Californian Lane Late navel had a large navel end caused by bud-mite problems. The Cambria navel tends to be elongated and small with good colour and smooth rinds. This kind of fruit is highly saleable in the Middle East.

(iii) Mandarins: Satsuma 70,000 cartons and Clementines; 80,000 cartons (90% is Nules). The thin rinds are a concern as this fruit is not suitable for export. Nules produced up to 80t/ha this year. The few hectares of Nova's are exported to the Far East (China), Middle East (Iran). Seven year old Nova trees produced 115t/ha. The fruit is harvested for a few weeks in early June when the rind colours naturally. The B17 (Valley Gold) and B24 (African Sunset) are planted in a semi-commercial trial. The B17 is preferred as this easy peeler has a deep orange rind colour, produces well and has good fruit size. The niche marketing of this variety resulted in a profit of R160, 000 per ha (AUD \$31,000). The B24 is not considered to be a commercial variety due to proneness to alternate bearing.

(iv) Valencia, 200,000cartons. Valencias produce better, pack-outs are higher, receive more for juice and have more options than navels. Midnight has proved to have variable yield and receives a regular GA at blossom (5-10ppm), has limited hanging ability and if the fruit is not harvested within 2 weeks it becomes puffy, rough and over mature. Delta has shown variable size and yield but hangs well. Turkey has clean fruit and holds its acid levels however it has a short picking period, few seeds and is earlier maturing than Delta and Midnight. Some rind breakdown has been experienced.

Sun Orange has established 245 ha in the Sundays River Valley, 28 ha Persimmons and 217 ha citrus. The reason for visiting this grower is twofold:

- (i) The high-risk cultivar profile adopted (217 ha), viz. Primosole (early Satsuma hybrid), Clemenpons (early), Or, Nadorcott (late mandarins), Fukumoto navel (early), Cara Cara navel (red), Autumn Gold navel (late) and Eureka seedless lemon. Unfortunately, this is only the second year of production and the grower is still optimistic about the future of the varieties planted. No significant problems were highlighted regarding any of the cultivars planted. One issue noted was the excessive sprouting and the formation of galls on Clemenpons.
- (ii) This company has moved to an Advanced Fertigation System (AFS) for the following reasons:
 - The nutrients are locked up and there is a build up of Magnesium in the soil
 - There is a poor imbalance of cations in the soil
 - The high volume of Sulphuric Acid in the soil causes soil sterility
 - Between 15 to 25 % more water is used
 - Soil compaction results in a anaerobic effect
 - TSS and acid levels are lower due to the dilution effect
 - There are no beneficial microbes in the soil

The following changes were made to AFS:

- Foliar feed, fulvic and humic acid, Calcium and Potassium was introduced
- Magnesium and Sulphuric Acid was omitted from the program
- Variable speed drippers were installed (5 cube/hour) and the trees irrigated daily with some water at first light

To add microbes in the soil, 20cubes/ha compost has been introduced around the dripper zone and or the whole area under micro-jet irrigation. A special waste plant has been installed that uses the following ingredients (end product): fruit (50%), manure (10%), green matter (20%); wood chips (20%). A hammer mills cuts up the branches and an inoculums added to the mix. The cost of making the compost is R110.00 (AUD \$21.00), excluding transport (major cost factor).

3.10 Packinghouse Practices

A very important service being offered to packinghouses is a packhouse hygiene assessment, referred to as Quality Monitoring Services (QMS), on a monthly basis. This is carried out using spore traps, to determine the fungal load at commencement and throughout packing. The aim is to proactively determine the waste potential during the picking season.

3.10.1 Naranja Packinghouse (Burgersfort)

The packinghouse capacity is 38 tonnes per hour with 650,000 x 15kg cartons packed last season.

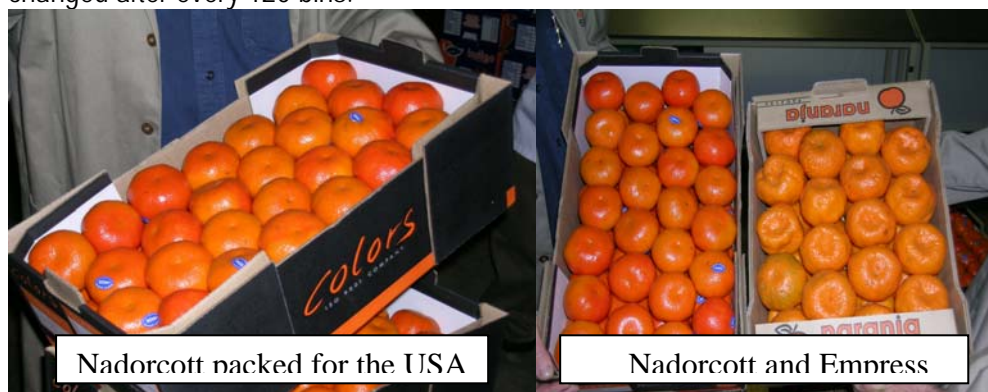
With the weakening of the Rand, the current export price for Afourer has been no better than domestic price, however the export market, while it is more risky, is where

the volume of fruit can be sold. Many different carton sizes and brands, including a 'rumble' pack for Marks and Spencer were being packed at the time of our visit.

The price for domestic (3rd Grade) 7kg was R45-50 per carton. The return for 1st grade fruit on the export market for 15kg cartons was R100 at the port. ClemenGold (i.e. Afourer) costs R0.63/kg to pack, with a cost of R10 for the 15kg carton. 'Rumble' pack cost 50% less to pack.

Shipping temperatures for mandarins is 6° – 7° C, navels and Valencia at 11° C during the early season.

Only one variety is de-greened at a time, for a max of 3 days. Fruit is drenched with fungicide (Decto and Scorpion) and dried before de-greening. The drench mix is changed after every 120 bins.



3.10.2 ALG (Citrusdal)

- Capacity is 700 bins/day, 45,000 bins / season, (17,000tonnes).
- Up to 10 cartons per bin are packed for the USA on most varieties, but pack-outs as low as 2.5cartons/bin was packed out for wind blemished late Washington navels.
- Fungicidal drench (including Tecto) is applied at receipt, 100bins/tank before disposal of the mix. A stand by tank has been installed for a quick changeover of the drench mixture as this is considered critical for their quarantine protocol. Fruit is left to dry overnight before putting into the de-green room.
- Six de-greening rooms are available, mostly with a 200-300-bin capacity and one with a 1,000 bin capacity, which is considered too big. It is standard practice to de-green one variety at a time. The de-greening time of 72 hours is the maximum time allowable. Thereafter the fruit is left to stand outside overnight to monitor colour. Ethylene is not applied until the gas chamber is up to temperature.

The maximum time from picking, packing and delivery to port ranges for 7 to 10days (de-greened fruit).

- The fungicide bath is heated to 20 degrees C to speed up the drying process.
- QA systems include Eurepgap, HACCP, Natures Choice, Field to Fork. Supermarkets do their own auditing. Consequently up to 9 audits are conducted per year.
- The shed keeps one carton per container at room temperature for monitoring quality of all export consignments.

- A fruit sticker is used to promote the 'Waitrose Foundation', a supermarket initiative for 'Black Empowerment', as this is perceived to give them a "competitive edge" in the UK.



Drenching facilities, ALG, Citrusdal

Returns for navels are around R95-100 in the USA. The Clementine price crashed to 3USD per 5 lb carton. European prices are 30% up on last year.

3.10.3 Cedarpack (Citrusdal)

Cedarpack consists of 3 directors / owners. Piet Smit does the marketing and Gert Kotze handles the production and finance. Cedarpack packs their own fruit, as well as for 5 other growers, totalling 650 – 700,000 cartons. The USA is the main market and several exporters, including Capespan, are used for other markets such as the Middle East, but do their own marketing in Europe.

Cedarpack averaged 7.5 x 15kg cartons/bin to the USA this year and between 30-40% of fruit can be shipped to the USA, up to count 88. The USA market is very good at present at 20-22USD on average per carton (R144-R154). Break even is expected to be 10-11USD, with spraying costs higher for this market. Chile wrecked the Clementine market in USA this year as they came in at the same time as the RSA fruit (earlier last year) and exported twice the volume estimated,

This shed starts packing from the end of March with Satsumas, followed by Clementines and Novas between April – May, tangelos, Navels and Lemons between June and mid August and late navels and Midnight/valencias to mid October.

The shed has 4 packing/process lines. There is no pooling of grower information during a packing run to maintain the integrity of the information going to the grower. A schedule of packing, freight and de-greening prices is available. Prices of different markets are pooled to share high and low prices.

From the weighbridge the bin is labelled with the farm name, variety and mass. Everything is drenched, 3 bins high, 150 bins/drench mix thereafter the chemical concentration is topped up and or changed. Drenching at receipt is critical. If the fruit is de-greened, bins stand outside to dry. Fruit (Clementine's and Navels) is de-greened from early April to mid-July. There is 1 week curing period between deliveries and packing in which the fruit wilts. This is done deliberately to allow the fruit to handle the cold transport and sterilisation process of -0.5 degrees C for 23 days.

The shed has 3 de-greening rooms, 2 x 450 bins, 1 x 260 bins, with an airlock at the front of the rooms for pallet storage. Clementines and Navels can be de-greened together using the Clementine temperature. Humidity must be accurate at 95%. Air circulation and ventilation is the key – they use a false ceiling to promote circulation. Tests for CO₂ build up is done daily. The de-greening room must be properly designed and mustn't get CO₂ pockets.

At the start of packing is a Chloride dip, and the ppm's are tested regularly. Then a fungicide bath and this is topped up 2/day and checked. Swab tests are taken around the shed and sent to a lab for culture. Formalin is used to sterilise the machinery in the packinghouse.

3.10.4 Dunbrody (Sundays River Valley)

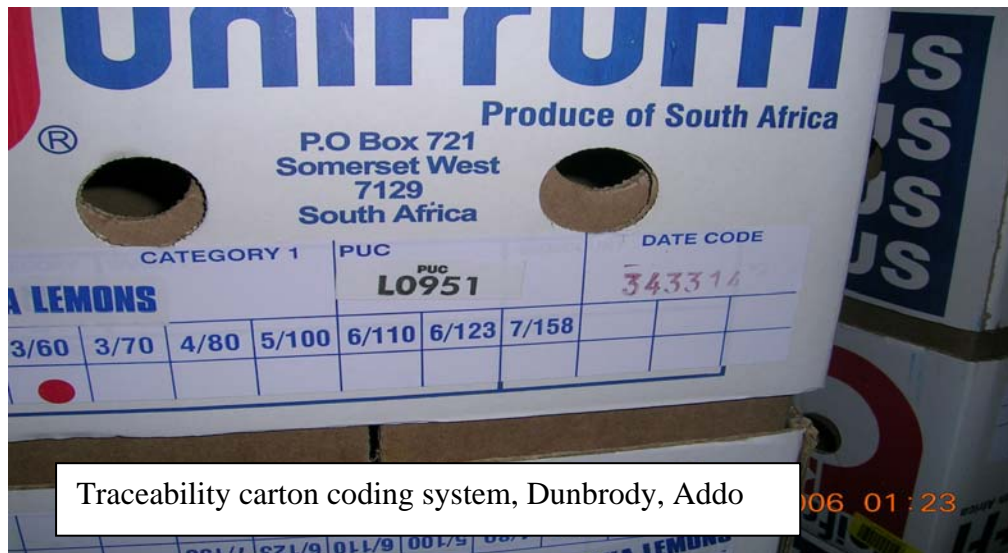
UniFrutti owns the packhouse and markets most of the fruit predominantly to the Middle East. The packhouse consists of 4 lines including a chemical free line for Italy, lemons, soft citrus and oranges (R70M investment), built between 2000 – 2004. They pack for 20 other growers and packed 2.3M x 15 kg cartons last year, including 800,000 of their own.

Packer wages average R70/day, with the best packer earning R100/day. The average packer packs 16,000 fruit per day at an average of 75 fruit per carton. This includes wrapping fruit when required (the low wages in Argentina are considered a threat).

The shed has 5 de-greening rooms, each with a 300bin capacity. Varieties may be mixed in the rooms. Fruit is drenched at delivery in a mixture of Spore-kill, Benlate, 2, 4-D and guazatine. The fruit stands overnight to dry before entry the de-greening rooms. It remains in the room for 1-4 days at 18-22 degrees C, depending upon fruit maturity.

Spore-kill is sprayed in the packhouse for line hygiene. One carton per pallet is inspected by an independent Quality Assurance company, based in their shed and charges R0.30c/carton. The key to post-harvest problems including decay is considered to be due to physical damage and split navels that are not detected, as decay is not a problem on sound fruit. To ensure as much potentially defective fruit as possible is detected staff are paid R0.10 per fruit removed (damaged skin or insect sting) by packers after the sorting process. In this way a further 10,000 fruit with potential decay was removed during the navel packing season.

The importance of not breaking the Cool-Chain after packing was stressed. For this reason the company provides loading facilities to ensure that this does not happen.



3.11 Production Costs

3.11.1 Northern Province: The following was quoted for Nadorcott

- Cost of Production – 10-15,000 R/ha (excl harvest costs),
- Picking costs 5 cents/kg (oranges 3 cents/kg),
- Packing costs 60 cents/kg,
- Carton cost 9 R/carton (15 kg carton),
- Transport to port R7/carton.
- Average profit is based on 40 t/ha – 80,000 R/ha.

There is a market for all sizes and grades of fruit with the strong markets being in the Middle East/Far East and Europe.

3.11.2 Western Cape: One grower advised that the packing cost for a 15kg carton is R21 and includes bin hire and transport to port. This is very low, R23 – R31 is normal, and R27 is probably the average for navels and R35 for soft citrus. Production costs are probably about half that of the packing costs i.e. R10-11/15kg carton. The other grower advised that the total packing cost is R27 for a 15kg carton. The picking cost for navels is R0.35/kg and R0.45/kg for mandarins. Workers picking with ladders get R0.03 – 0.05c per bag more. Workers generally earn R240-600 per week. Contractors with their own equipment charge R36/bin, if they used their own farm equipment, the charge will be R30/bin.

3.11.3 Eastern Cape: The production costs including depreciation (R2000/ha), harvesting and freight to packhouse are as follows: Valencia- R25-35 000/ha; Navel; R35-40 000/ha; Lemons; R45-55 000/ha; Soft Citrus; R30-40 000/ha. Packing charges average R20/carton including the cost of the carton (R10), levies and freight to the port. Valencia = R17; Navel = R20-22; Lemons R20. Growers expect to receive a minimum of R45/carton to break even.

4. Implications for Australian horticulture

- a. The significant increase in the South African citrus crop will compete more heavily with Australian citrus exports in future. Improvement in fruit quality and size and reduction in labour costs will be essential to remain competitive in future.

- b. Devastating diseases such as greening disease (Asian greening in particular), citrus canker, etc. remain a major threat to the survival of the Australian citrus industry. Current phytosanitary control measures should be reinforced and improved where appropriate. The area freedom status of South Australia is considered to be a major competitive advantage for Australian product and should be protected at all costs. Expansion of area freedom to other citrus producing areas of Australia should be a high priority. The introduction of a citrus nursery accreditation scheme to ensure the production of horticulture superior, disease free trees in Australia is a key element in retaining and improving the phytosanitary status of citrus production in Australia.
- c. Market access remains a high priority for all exporting countries. The strategy in existing and new markets should be continuously reviewed as our competitors appear to be gaining ground in markets for which Australia do not have access such as Iran.
- d. The impact of an inadequate R&D focus and lack of suitably trained staff is that the Australian citrus industry will not be able to stay ahead of the game by implementing cutting edge technology in a bid to apply world best practice.
- e. The commercialisation of new citrus cultivars is a business. It is anticipated that new variety releases will require the payment of tree and or production royalties and will be subject to pre-determined terms and conditions in future. Australia needs to participate in the cultivar commercialisation arena in order to remain a global player in the market.
- f. The implications of planting Nadorcott (Afourer) mandarin in Australia without the owners consent, requires clarification. The implications for the company responsible for the importation of Nadorcott material could be significant. The Nadorcott is an excellent variety that can be planted successfully in most citrus producing areas of the country with the proviso that the correct crop manipulation techniques are applied and cross pollination is avoided to produce seedless fruit. The MOR mandarin from Israel appears to have greater potential under Australian conditions than OR. The MOR should be compared with the low seeded Murcott selection released by QDPI. The niche marketing of seedless lemons has potential, particularly in the warmer citrus production areas of Australia such as Queensland (earlier fruit maturity, thinner and smoother rinds, etc.). Approximately 12 varieties have been identified for importation into Australia but the majority are licensed varieties.
- g. Proactive monitoring of harmful spores in the packinghouse appears to be standard practice in South Africa whilst retention of the cold chain from picking, packing and transport into the market place is well managed in accordance with strict protocols. The cold chain initiative launched by the Cold Chain Centre (Australia Logistics Assured) in Australia last season is a good initiative to reduce potential waste losses in the market place and should be expanded on a commercial basis. Packinghouse procedures for de-greening and drenching are fairly uniform in the packinghouses visited and should be incorporated

as a best management practice manual as this will reduce the risk of high losses in the market place caused by decay.

- h. Fungicide resistance is a major concern that requires urgent investment in research and development in Australia. If this issue is not addressed, fungicide resistance will increase and market share lost as a result of poor outturns.
- i. A number of research and development results and cultural practices have been listed for testing under different climatic areas in Australia. These initiatives could save costs and increase overall grower returns.
- j. The development of an Integrated Crop Management Access System that consolidates all the recognised accreditation standards in a one-stop electronic food safety information system is an excellent initiative. Australian citrus growers will benefit significantly as such a system will enable greater access and flexibility of programme sales into different market segments.
- k. The benefits of biological farming in Australia, deserves further investigation as this may the way forward in future.
- l. Initiatives to reduce labour costs and dependency on labour in areas such as harvesting and packing should be a very high priority in Australia to remain competitive.
- m. Key industry differences between Australia and South Africa can be summarised as follows:

Australia	RSA
Strong domestic and export market	Export reliant
Weak R&D focus	Strong R&D focus
Lower phytosanitary risk	Higher phytosanitary risk
Superior external colour and eating quality	Paler colour and lower brix
Highest labour costs in OECD countries	Labour availability

The advantages and challenges of the Australian citrus industry include:

(i) Advantages: superior eating quality; extended fruit maturity; "clean, green" image (AQIS); "area freedom" in South Australia; counter consolidation (corporate investment); government funding initiatives and strict import quarantine regulations;

(ii) Challenges: strength of the AUD; cost of labour and power (fuel); salinity and environmental management (drought); market access/industry barriers; exploitation of area freedom; infrastructure/communication; counter rationalization versus retail expansion; food safety/traceable products/audits/QA; R&D support; technology transfer and training.

5. Dissemination of Information

The final report will be posted on the ACG website and put on CD for distribution to the industry. Industry groups can be addressed if required.

6. Itinerary

Wed 9 August: Arrive Johannesburg

Thurs & Fri 10-11 August: Du Roi-citrus nursery practices, Nadorcott plantings, services, etc.

Mon 14 August 6.30: Nadorcott orchards and packing operation in Burgersfort: Dr Hennie le Roux, and Japie Kruger; Citrus Research International (CRI): Dr Tim Grout and research team; James Warrington, Karino, orchard practices and management of greening disease.

Tues 15 August: Institute for Tropical and Subtropical Crops (ITSC): Dr Arthur Sipple- breeding program; Depart Nelspruit for Cape Town.

Wed 16 August: Citrus Research International-Prof Vaughan Hattingh, CEO and Drs. Stephan Verryne, Graham Barry and Paul Cronje (pre and post harvest horticulture); field visit to Welgevallen Experimental Farm. Citrogold: Bruce Cook, Variety Commercialisation Company

Thurs 17 April: Depart for Citrusdal, visit Zonquasdrif en route-Mor, Or and Nadorcott plantings. ALG Estates-All van der Merwe and Kenny Beeton-orchard practices and packinghouse visit.

Fri 18 August: Mouton Citrus-Johan Mouton and Henk du Plessis, production practices and new varieties. Cedar Pack, Gert Kotze, packinghouse technology

Sun 20 August: Depart for Port Elizabeth

Mon 21 August : Dunbrody Estate, Deon Joubert-production practices and packinghouse technology. Addo Research Station – Johan Maritz and Nikki Combrink-breeding programme and variety evaluation.

Tues 22 August: Citrus Foundation Block-Mr Thys du Toit-Citrus Improvement Programme; Sun Orange, James Hannah-new varieties and use of organic material.

Wed 23 August 8.30: Return to Australia.

7. Recommendations

(a) Research & Development:

The Australian citrus industry needs to review its strategic direction in terms of skills/resource utilization and industry consultation to develop

and set R&D priorities, technology transfer, industry partnering in R&D, etc.

(b) Nursery Practices: The Australian citrus industry needs to review its policy on implementing a more formalised nursery accreditation scheme to protect the industry from the spread of harmful diseases and pathogens such as citrus canker, greening disease, phytophthora, pithium, etc. Tree uniformity and improved tree health at the time of planting will result in significant savings as well as protection of the genetic integrity of plant material.

(c) Cultivar Development: It is important to leverage **Australian bred varieties** nationally and internationally with minimal impact on Australian growers. An independent variety Committee with knowledge in the variety commercialisation field should be established to direct the process forward and maximise opportunities for the country. It is equally important to ensure that adequate research information is available on the performance of Australian bred varieties throughout the value chain as this will add credibility and help speed up the commercialisation process in the world. Income generated from the commercialisation of industry bred varieties will assist in off-setting the high costs of a breeding program. **Auscitrus's** involvement in the acquisition and commercialisation of new citrus varieties should be clarified. **Varieties** worth importation and or further evaluation in Australia include: Mandarins: WH/B/2/36; Valley Gold, African Sunset; Clemcott; Hadas; Grapefruit/hybrids: Flamingo and Pomelit; Navels: Washington mutant; Fukumoto (re-import); Glen Ora Late; Kirkwood Red; Valencias: Turkey; Ruby Valencia. The Nova is worth reconsidering in the Riverland. With regards to new promising varieties imported into Australia, the following:

(i) Nadorcott:

- Resolve the ownership rights in Australia.
- Develop a cross-pollination strategy to reduce seediness in Nadorcott.
- Develop a crop manipulation strategy for each production area, including Queensland.
- Determine the terms and conditions of the Tangor from the USA

(ii) Mor:

- Compare the Mor with the seedless DPI selections
- Establish semi-commercial plantings of seedless Murcotts
- Determine a fruit set strategy in the early production years

(iii) Orri

- Avoid planting in dry arid conditions but consider planting for the Asian market.
- Implement a production strategy to control tree size and optimise fruit set and size.

(iv) Seedless lemon

- Compare with the seedless source in Australia.
- Determine the market potential in Australia and high value export markets such as Japan.
- Compile a fruit set and size strategy for any plantings established.

(v) Valencias

- Midnight plantings must be monitored for copper deficiency and treated accordingly.
- Delta fruit set and size must be monitored and a strategy developed where problems occur.

(d) Cultural/farming practices

- The relevant cultural practices should be tested to improve yields, fruit size and quality as well as reduce splitting, creasing and peteca (lemons only).
- The viability of producing mulch commercially for biological farming requires investigation.

(e) Packinghouse practices

- The hygiene must be reviewed to proactively determine the waste potential during the packing season so that correction action can be taken and losses reduced to a minimum.
- Packinghouses that do not drench fruit for export should review their practices and procedures.
- The de-greening, storage and shipping protocol requires review.
- Australian packers should compare current practices applied in South Africa and changes implemented where appropriate.

8. Acknowledgements

Our sincere thanks and appreciation is conveyed to HAL and the citrus industry for making this visit possible and affording us the opportunity to gain very useful information. Graham Barry's assistance with the arrangements of this visit is greatly appreciated as well as the willingness of all growers and institutions willing to share information with us. The knowledge and experience gained during this visit is invaluable.

9. Contact List

Name	Position	Institution	Contact details
Dr Graham Barry	Manager: Cultivar Development	Citrus Research International (CRI)	gbarry@cri.co.za tel. +27 21 808 4105
Prof Vaughan Hattingh	CEO	CRI, Stellenbosch	vh@cri.co.za tel. +27 21 882 8553
Dr Stefan Verreyne	Research Horticulturist	CRI, Stellenbosch	sv@cri.co.za tel. +27 21 808 2825
Paul Cronje	Research Horticulturist	CRI, Stellenbosch	pc@cri.co.za tel. +27 21 808 2689
Dr Hennie le Roux	Extension Manager	CRI, Nelspruit	hle@cri.co.za tel. +27 13 759 8000
Dr Tim Grout	Research & Technical Manager	CRI, Nelspruit	tg@cri.co.za tel. +27 13 759 8000
Japie Kruger	Irrigation Consultant	Nelspruit	ohss@telkomsa.net tel. +27 828 795 139
James	General	Karino Citrus Co-	Karkoop@iafrica.com

Warrington	Manager	op	tel. +27 13 747 2101
Abraham van Rooyen	CEO	Du Roi Company	abs@duroi.co.za tel. +27 15 345 1650
Bryan Offer	Managing Director	Du Roi Citrus Nursery	bryan@duroi.co.za tel. +27 15 345 1650
Dr Fanus Swart	Manager	QMS Agri- Science	fanuss@agriscience.co.za tel. +27 15 345 1227
Dr Arthur Sippel	Manager, Cultivar Development	Agricultural Research Council (ARC), Institute for Tropical and Sub-tropical Crops (ITSC)	Arthur@itsc.agric.za tel. +27 7577037
Nikki Combrink	Citrus Breeder	ARC, Addo Research Station	combrinkn@arc.agric.za tel. + 27 42 233 0342
Johan Maritz	Citrus Breeder	ARC, Addo Research Station	maritzj@arc.agric.za tel. + 27 42 233 0342
Bruce Cook	Managing Director	Citrogold	bcook@citrogold.co.za tel. + 27 21 882 8277
Kenny Beeton	Operations Manager	ALG Estate	kvbeeton@absamail.co.za tel. +27 22 921 3544
Gert Kotze	Director	Cedarpark	gert@cedarpark.com tel. +27 22 921 2636
Johan Mouton	Managing Director	Mouton Citrus	johan@moutoncitrus.co.za tel. +27 22 921 3405
Henk du Plessis	Operations Manager	Mouton Citrus	henk@moutoncitrus.co.za tel. +27 22 921 3405
Deon Joubert	General Manager	Unifrutti-Dunbrody	Deon@dunbrodyestates.co.za tel. +27 42 230 0498
James Hannah	Director	Sun Orange	jimbo@kirkwood.co.za tel.
Thys du Toit	Manager, CIP	CRI, Uitenhage	TDT@cri.co.za tel. + 27 41 992 5366