Study Tour to Review the Drought Strategy in South Africa: 15-25 July 2007

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Valencia trees with plastic mulch-Letsitele

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1. Media Summary

The drought in 1991 and 1992 was commonly regarded as the worst recorded in Southern Africa this century. Areas that were affected by drought in South Africa are mainly located in summer rainfall areas. Some of these areas continue to be at risk to drought as water storages can be low prior to the start of summer and the main rainfall period. The objective during the drought was to maximise water usage, minimise moisture loss and save the tree. The strategy adopted in these areas is to set as heavy crop as possible on the chance that it is going to rain and there will be sufficient water for irrigation of the crop.

After consulting scientists, consultants and growers it was concluded that during periods of drought it is important to manage risk and maximise profitability. In order to achieve this, the following key issues should be considered to maximise water usage, minimise moisture loss and save the crop and the tree:

- Know the financials of your orchards
- Review the irrigation system and adapt timing, application rate/area and volume according to the different phenological stages of the tree, variety and rootstock type.
- Determine the depth of the root zone for each patch and avoid irrigating below the root zone.
- Mature trees: set a normal crop on profitable orchards and remove orchards that are marginal and or unprofitable; young trees: apply a normal maintenance program.
- Do not cut back trees until absolutely necessary-rather allow natural defoliation and prune the trees back when water is available again.
- A different nutrition strategy should be adopted for patches where a crop is set and patches are in survival mode. If salinity is a concern, use fertilisers with a low salt index such as calcium nitrate or consider applying a non bearing tree fertiliser solution. Do not irrigate orchards with saline water.
- The strategy during flowering is critical on orchards identified to set a crop as there is only once chance in a season to achieve fruit set, i.e. protect the majority of blossom that is least protracted.
- Chemical fruit thinning to drop a crop is not considered a good option.
- Manage water in line with fruit size growth.
- Commence a replant program as soon as possible to avoid negative cash flow in future.
- Monitor and treat trees with collar rot and consider nematode control options of mature bearing trees if a major problem.
- The cost of applying organic and or plastic mulches in Australia may be to prohibitive compared to the benefits.
- Further research is required on anti-transpirants as research to date appears to be inconclusive.
- Have a clearly devised plan, be flexible and seek continued assistance as you will not be alone.

2. Expected Outcomes

2.1 Aim: The value of citrus in Australia is estimated to be in the region of $420 million and is the largest fresh fruit export. The drought affected areas in Australia represent in excess of 70% of the total acreage and production in Australia. The social and economic effect of the drought in these regions will have a significant impact on the industry should the incorrect drought strategies be put in place. Although a number of drought control strategies have been documented in Australia, practical experience on handling a drought over an extended period of time has not been experienced over large parts of the industry to date. The key objectives of this study tour were to meet with growers, scientists and consultants, to determine the most appropriate drought strategy under Australian conditions.

2.2 Key issues to be addressed: These include:

(i) Irrigation: water requirements during different phenological stages of the tree, i.e. what is the minimum amount of water required to set a saleable crop; water scheduling; maintenance; filtration, pressure; depth; conversion, etc.

(ii) Nutrition: inline versus foliar; fertilizer types (chelates, etc.); salinity.

(iii) Canopy management: Leaving the tree versus stag-horning; hedging; pruning.
(iv) Crop manipulation-Severity of crop reduction/removal; growth suppression; GA sprays; fruit thinning, timing, etc.
(v) Evaporation management: mulches, chemicals, etc.
(vi) Transpiration management: identifying new products/strategies to reduce transpiration without affecting crop flowering, set, growth and quality.

2.3 Benefits to the industry: The intended outcomes of the tour include to better equip citrus growers in drought affected areas of Australia to plan for different water allocation scenarios and introduce drought strategies on their respective properties that will reduce economic, environmental and social risk in their region.

3. Results and Discussion

3.1 Introduction

The drought in 1991 and 1992 was commonly regarded as the worst recorded in Southern Africa this century. Areas that were affected by drought in South Africa are mainly located in summer rainfall areas. Some of these areas continue to be at risk to drought as water storages can be low prior to the start of summer and the main rainfall period. The objective during the drought was to maximise water usage, minimise moisture loss and save the tree. The strategy adopted in these areas is to set as heavy crop as possible on the chance that it is going to rain and there will be sufficient water for irrigation of the crop.

The socio-economic impacts of the drought in Southern Africa, is forever increasing as greater demands by an increasing population are already placing pressure on the available water resources. The future impact of limited water to the South African citrus is not as a result of a lack of rain, but a result of urban expansion. Urban expansion is increasing at a rapid rate and dam storages are not increasing and it is likely in the short to medium term that there will be a shortage of water for irrigation as water will be supplied for urban use firstly.

Growers, consultants and scientists involved with this drought were consulted and the outcome summarised below:

3.2 Management Plan

There are ultimately two choices leading into a period of reduced water allocation and the uncertainty of additional irrigation water or rainfall, (i) make every attempt to set a normal heavy crop on bearing trees or (ii) don't set a crop at all and manage the trees for survival. There is no in between. Financially there is no easy answer and it is really a matter of managing risk and maximising profitability. It is considered more economical to remove poor performing and marginal producing orchards rather than cut the trees back. Knowing the profitability of your farm and more importantly each orchard cannot be overemphasized. The importance of implementing a replant programme was emphasized as less water is required to maintain the trees and cash flow is not disrupted following the drought. It is essential to get your irrigation right but nothing beats good rainfall!! Available water and tree numbers should match, i.e. if 50% water is allocated set 50% of the crop. One of the mistakes made by the South Africans during the drought is that information was not recorded. It remains essential to record all information for future reference in the event that the same situation may arise.

3.3 Irrigation Management

Drip Irrigation: Water savings of 30% -40% have been achieved (from 12 ML to 8 ML per ha) and production is reported to be higher. These savings are similar to results achieved in Australia. This irrigation system is a lower buffer for drought therefore, once you fall behind it is difficult to catch up. Continuous fertilizer applications are necessary and cannot be split like micro irrigation. Drip irrigation shows signs of stress quicker than micro. Regular maintenance and flushing of drip systems is important. Pulsing is a good way to save water but the irrigation system should be adequately designed for this practice.

Micro Irrigation: A deflector can be placed over the micro jet to concentrate the water application in a reduced wetting area of the tree. A different micro can be used to reduce the water application rate. Trees can be irrigated less frequently (every three days) than with drip irrigation. Split fertiliser applications (three) is possible with micro.

General Irrigation Practices: Daily irrigation assuming full allocation is best practice with no more than two pulses being applied per day for systems that are not hydraulically designed for pulsing. The industry is generally moving away from systems with multiple pulses as many of the systems are not suitably designed and the benefits are not justifiable. Pulsing is particularly important in the establishment of young trees.

During drought, irrigation pulses are reduced from two and a half hours to a root depth of 250-300 mm. In Letsitele most of the water is withdrawn from March to the end of July depending on the variety. Irrigation was limited to one irrigation schedule per week instead of every second day. During December to February, trees produced a crop with 50% of their normal water allocation per tree per day. In winter, watering was reduced to every third day. Tensiometers were not very effective during drought.

Determining the root zone depth is critical to achieve the best results possible, irrespective of during drought or under normal conditions. However when experiencing a drought and water allocations are reduced, determining the root zone depth becomes even more critical. The root zone depth can be considered as the area containing 70% of the feeder roots. The depth of irrigation and timing is critical in the event of reduced allocation. Better results were achieved in applying irrigation every 3-4 days rather than weekly when reduced water applications were applied to sprinklers, however, the depth of wetting should be such that the majority of the feeder roots are wet with each irrigation cycle. It is therefore important to know the depth of the feeder roots in each patch.

Micro irrigation – wetted area can be reduced in drought

In the drought of 1992/93, there was very little drip in place and the majority of orchards were irrigated using micro-sprinklers. Reducing the wetted area was a key practice used to minimise evaporation and to concentrate water in a smaller area around the root zone. Trees were watered once per week with trees only receiving 27% of the normal tree requirement. Trees survived the conditions and it was suggested that had trees been on drip and been watered every 3 days, similar results would also have been achieved. The objective when determining how much water was sufficient to keep the trees alive was that no visual stress should be observed before 10-11am.When reducing the surface area, the output of the water needs to be reviewed relative to the root zone depth as applying the same volume of water over a smaller area can result in applying water below the root zone depth. The time of application will become critical as well as the frequency of application. Additional management will be required to minimise the chance of over wetting the smaller area which could lead to root rot and phytophthora. Essentially trees will be managed similar to drip irrigation which obviously requires more management.

Applying water following fruit set is critical to enable fruit size to be maximised. The full irrigation requirement was applied for a period of 66 days. Water is generally reduced for some varieties to improve fruit quality, as is the case with Satsumas, Clementine and Delta Valencia.

The timing of irrigation is very critical when limited water is available. Applications at night reduce surface evaporation and evaporative losses through wind and high temperature compared to applying during the day. The timing of drip irrigation is less critical, however, if water is being applied as a means of survival and trees are not being watered daily, then night irrigation should be considered in order to capitalise on lower power costs. Water can be managed during phase 4 according to fruit size growth curves.

Extremely high salinity levels were experienced with borehole water resulting in a pruning effect. An EC above 1200 to 1400 becomes a problem. In the Sundays River of the Eastern Cape, chloride levels increased to 700 ppm. The trees survived while water availability was limited, but died quickly when they ran out of water. The application of saline water can potentially kill plantings. Farmers in the Sundays River Valley of South Africa that irrigated with high saline water killed trees. Farmers that chose not to irrigate with saline water managed to retain trees after an extended drought.

3.4 Pruning & Canopy Management

Crop and tree manipulation ultimately comes back to the two options that are available, crop or do not crop. If cropping, then ultimately the tree will be managed for maximum production. Should water allocations not be sufficient after the decision has been made to crop, then the crop should be left on the tree as not only is it expensive to remove the fruit but the fruit will remain as water sink to the tree. The reason for this is that the fruit have no stomata and will loose less water than leaves. If the decision is made not to crop then the decision should be made as early as possible to remove the crop. Removing the crop is obviously difficult however a large percentage of the fruit shouldn't set with reduced water applications through flowering and fruit set. If a light crop remains, fruit can obviously be removed by hand, however, it is not essential. If the crop is to be removed through chemical means, it will most likely only be effective if the tree is not under stress as the application of chemical thinning agents can potentially cause greater stress to the tree.

Opinion on the canopy management strategy under drought conditions in South Africa differs. Farmers have a tendency to want to do something rather than nothing and pruning back is the obvious consideration. The two main opinions are:

1. Complete defoliation of the tree is not considered to be a good approach as there is a greater chance of tree fatality as opposed to cutting the tree right back before total defoliation. Pruning back stimulates regrowth and trees continue to use soil moisture. Pruning back trees also increases orchard temperatures and thus when small amounts of water can be applied, surface evaporation is far greater, particularly with micro irrigation. The suggested approach is to remove no more than 1/3 of the tree. However, if tree stress continues and leaf drop occurs, reduce tree size by a half. Should water allocations be unlikely to improve and the tree condition continues to deteriorate, stumping and painting should be considered i.e. stag horn the tree before it gets too late. Following heavy pruning,

a mixture of NAA, paint and oil is applied by hand to prevent sprouting. The cost of pruning back is a significant cost and estimated to be in the region of $5-6 dollars per tree. Once the tree is cut back it will take two to three years before production will resume, therefore the option of replanting older orchards or low profitability orchards needs serious consideration.

2. The other opinion is that citrus is incredibly resilient and that the canopy should be left to defoliate until water is available. Allowing leaves to fall reduces crop water use and evaporative losses. Following defoliation and the resumption of water allocations or the end of the drought, a decision can then be made on how hard to prune back the tree. The reason for this is that if conditions change the tree is ready to grow and set fruit again. The ability to return to cropping is quicker allowing for complete defoliation as opposed to stumping or cutting the tree right back as there is likely to be a far greater percentage of the tree that has survived. Despite small twigs and branches dieing with rapid moisture loss, it will take a considerable amount of time for the majority of the tree to die even after defoliation. However, the time between defoliation and a full allocation of water being received is critical. Pruning back trees was never really considered an option as replanting unprofitable orchards enabled enough water to be saved. This strategy was implemented in the Eastern Cape during the 1970's and in the Northern Province (Messina) in the 1990's. Growers that didn't do anything with trees achieved very positive results.

After many years, research has continually shown that trees can survive on much less water. The evolution of drip irrigation whereby water application has been reduced by 35-40% is proof that this is possible.

The strategy during flowering is critical on orchards identified to set a crop i.e. what set do you protect? Under water stress conditions, sporadic flowering may be experienced and only one chance is available to set a crop on flowering buds. The aim is to target the highest concentration of flowering buds over a two week period as it is critical to focus on a narrow bloom. The more protracted the bloom the greater the impact during harvest, i.e. if flowering is 4 weeks later, harvest will be 6 weeks later. If blossom timing is early treat as the main blossom but caution against late frosts as this could result in total crop loss. During this period it is also important to ensure irrigation and nutrition is optimal.

3.5 Nutrition Management

Fertiliser inputs should be heavily reduced with reduced water allocation and ultimately, water use will determine tree fertiliser requirements. With low water allocations, little consideration should be given to elements such as P & K, with the majority of the attention given to the management of N. However, one consultant considers K to be important. With sprinkler irrigation, spring applications could be avoided until allocations improve to provide greater confidence that will allow the cropping of patches, assuming the trees are starting with good base levels of nitrogen. Nitrogen is the key nutrient and should be applied according to the crop load expected. The decision on when to fertiliser and the quantity ultimately rests with the two strategies that can be adopted i.e. to set a crop or not to crop. If not cropping then obviously no fertiliser should be applied. If cropping, the fertiliser timing and program will be in line with normal nutrition philosophies and practices.

As fertiliser is a salt, not applying fertiliser during periods of deficit irrigation is considered to be a positive to avoid any unnecessary tree stress. In Letsitele, one grower withdrew Potassium Chloride but experienced small fruit size and very thin rinds after the drought.

Water quality is a serious issue when heading into a drought. No problems should be experienced if water quality is less than 1250EC units. Of importance is to ensure that salinity within the root zone is also less than this. The use of alternative water sources with high salinity can essentially be counter productive and in most cases, trees are better off receiving no water than highly saline water, unless the salinity can be overcome.

Red grapefruit irrigated with water with high salinity-Letsitele

If salinity is a concern, use fertilisers with a low salt index such as calcium nitrate. Alternatively consider applying a non bearing tree fertiliser solution during the period where the salt index is normally high due to the need to apply higher amounts of nutrients such as N i.e. during the period from bud swell to flowering. After flowering, the water requirements generally increase and the fertiliser requirement decreases. Therefore the normal nutritional program can be adopted as the cumulative salt index of the fertilisers will be relatively low despite a wider range of nutrients and higher concentrations of the stock fertiliser mix increasing.

Calcium Nitrate should be used if there is an issue with high sodium or chloride as opposed to any other nitrogenous sources, however, if the conductivity of water increases it is important to identify what salts have increased. It remains important that trees should not experience major fluctuations in conductivity.

Generally P is banded and with reduced irrigation there is no need to apply this product.

Foliar fertiliser are applied during Phase 4, however, when trees were wilting during other growth phases such as prior to harvest, there was no need to apply foliar fertiliser. Foliar applications can be applied after rain to accelerate the process.

Copper shouldn't be limiting as copper is very important in the formation of the waxy cuticle. If the waxy cuticle is not formed correctly, transpiration will be greater.

Sprinkler irrigated orchards with high salinity-Letsitele

3.6 Disease Management

Phytophthora is not generally considered to be an issue with reduced irrigation, however, concentrated irrigation during drought conditions could increase Phytophthora infection if over watering around the stem of the tree occurs (collar rot). Phytophthora is controlled initially with Ridomil followed by an application of potassium phosphite.

Nematodes will have a greater impact than phytophthora during a period of deficit irrigation and greater attention should be given to this issue according to specialists in this field. Root samples of selected patches should be analysed for citrus nematode. Monitoring patches 5-10 years of age is far more critical than investigating old mature orchards that are likely to have higher nematode populations. Old patches high in nematode populations are potentially not worth treating as the benefit may not be achieved before the tree is replanted. During the early years of tree establishment following the replanting of citrus, nematodes are not an issue as soil temperatures are high enough to kill eggs of surviving nematodes. However, some eggs have the ability to survive up to 9 years. With the development of the tree canopy with tree age, shading increases and thus egg survival and nematode population expansion can become a major issue.

Nematode control is best achieved using Rugby, particularly in high pH soils. Rugby works very well in sandy soils. Nemacur is only effective in low pH soils. The application method of nematicides is important as the product should be washed in the soil correctly (band placing is ineffective). The threshold based on Citrus Research International research is 1000 females per 10gm roots. Tests are generally conducted in orchards in South Africa every 3 years and a significant amount of attention is given to the investigation and control of the pest. A nematode problem is difficult to identify without a root count, as when a nematode problem becomes visual, it is too late as opposed to phytophthora that is easily identified and controlled relatively quickly following treatment.

Growers in Letsitele and Marble Hall do not control nematodes due to the high cost. Some growers use the nematode tolerant rootstock Swingle citrumelo. In the advent of reduced water allocation and limited winter rainfall to effectively move the surface applied Rugby into the soil, a once off application through the irrigation water can be considered. The application of Rugby with irrigation water is not recommended normally as Rugby does not move very much in the soil. Consequently, only roots directly under the drippers will be treated and roots outside the wetted area will not receive treatment and nematodes will continue to feed and then move back onto the roots under the dripper. A single application may be sufficient to suppress attack until water allocations improve and allow the control of the root system. Under normal conditions, Rugby is either applied as a strip spray along the drip line in a 1 meter wide band or applied in a 1m wide band prior to rainfall. Both treatments will require rainfall to move the chemical into the root zone.

The management of nematodes is a difficult process and most growers will tend to live with them and manage them as opposed to control them due to the high cost. Assessing the health of the roots is important in order to maintain production. If nematodes are a problem or going to become a problem, it is economically a better decision to replant an orchard as the economic performance of the patch would have indicated a problem, well before a nematode test is conducted.

3.7 Rootstocks

Citrus literature supports the fact that Rough lemon is one of the most drought tolerant rootstocks available. Rough Lemon is a rootstock that traditionally has not been widely used due to its attributes to produce fruit with low TSS and lesser quality compared to the more traditional rootstocks such as Sweet Orange and the Citrange rootstocks. Within South Africa, approximately 15% of plantings are on rough lemon. Many growers found that Swingle citrumelo performed very well during periods of reduced water allocation. Swingle is a commonly selected rootstock along with Citrange, C35 and X639. Lemons on X639 rootstock perform well and oranges on C35 and Minneola x Trifoliata hybrid performed quite well compared to citrange rootstocks in the Marble Hall area.

When considering replanting, the use of rough lemon and other drought tolerant rootstocks can be considered. This is in light of temperatures increasing with global warming and water resources becoming more limited. Rough lemon is a rootstock that has the ability to generate feeder roots quickly. However, fruit quality needs to be considered.

Rangpur lime is the most drought tolerant rootstock but very prone to phytophthora. Care should be taken with the use of Trifoliata rootstock as it is sensitive to salt.

3.8 Replanting

It is widely accepted that drought is a very good time to consider the removal of unprofitable patches and consider replanting. Decisions that have been delayed should now be made. In South Africa 3 to 4% of trees are replaced per annum to ensure that no more of their orchards are greater than 35 years of age but will also depend on orchard size. Many orchards in the north consist of common Valencia types and the profitability of the older orchards is very poor. Therefore if reduced water allocations are likely, replanting is implemented. Young trees that had been replanted were retained as water use was minimal and unaffected by the drought.

3.9 Mulching

Mulching is a practice that is not used widely to conserve water. Many other practices such as watering at night, leaving skirts to hang lower would be far more cost effective than applying mulch. Mulches have the ability to absorb large amounts of moisture before they become effective in conserving water. In a research trial, mulching had no impact on tree survival. Plastic mulch tested commercially at one site resulted in difficulty with irrigation scheduling and the holes in the plastic clogged up with soil. The risk of phytophthora

increased significantly despite the plastic containing small holes to improve soil aeration. Removing the plastic was a difficult exercise and was unable to be completely removed. Compost is also being tested on the soil surface to improve the soil structure but caution against collar rot.

In the Eastern Cape, one grower believes plastic mulching is a good option to minimise evaporation (2 year old Lane Late navels on rough lemon and citrange rootstock). The plastic was laid in strips down the row with the drip line on top of the plastic. Holes were made below the dripper (20 x 20 cm) to maximise water penetration. Cutting the holes reduces the risk of phytophthora but not collar rot. This is considered too labour intensive and costly in Australia. Lucerne has also been used successfully in this region due to the high nitrogen content of 2%.

Plastic mulch-Lane Late navels-Eastern Cape

One estate mulches third grade oranges and increased the tonnage of marginal orchards by 20 tonne per hectare. The problem with mulching remains the logistics and cost of getting straw, grass, fibre, etc.

Mulching dripper irrigated plantings can stop salt coming to the surface as the ability to leach salt will be lost.

Plastic strips next to dripper under the soil

The new direction appears to be putting microbes back in the soil. It is an expensive option and the return on investment questioned for this long term strategy. Microbes need a carbon source and very good results have been achieved in vegetables in the short term. A starter pack is being developed in South Africa. Treatment of citrus is more a long term option.

3.10 Anti-Transpirants

There is limited knowledge in regard to the use of anti-transpirants. Surround is one product that has been used to reduce sunburn in varieties such as satsumas. Results also found that evaporative losses are reduced however the use of Surround is reported to exacerbate red scale and mite problems. The suppliers of Surround are currently working on a formulation that is less disruptive to mites and red scale. Products such as Vaporguard could potentially be trialled however it is likely to have limited benefit.

3.11 Variety Management

Seeded varieties will perform far better with reduced irrigation than seedless varieties (pollen sterile varieties excluded). Specific reference was given to seedy Valencia types versus Delta and Midnight Valencia and Seedless lemons.

4. Implications for Australian Horticulture

During periods of drought it is important to manage risk and maximise profitability. In order to achieve this, the following key issues should be considered to maximise water usage, minimise moisture loss and save the crop and the tree:

- Know the financials of your orchards
- Review the irrigation system and adapt timing, application rate/area and volume according to the different phenological stages of the tree, variety and rootstock type.
- Determine the depth of the root zone for each patch and avoid irrigating below the root zone.

- Mature trees: set a normal crop on profitable orchards and remove orchards that are marginal and or unprofitable; young trees: apply a normal maintenance program.
- Do not cut back trees until absolutely necessary-rather allow natural defoliation and prune the trees back when water is available again.
- A different nutrition strategy should be adopted for patches where a crop is set and patches are in survival mode. If salinity is a concern, use fertilisers with a low salt index such as calcium nitrate or consider applying a non bearing tree fertiliser solution. Do not irrigate orchards with saline water.
- The strategy during flowering is critical on orchards identified to set a crop as there is only once chance in a season to achieve fruit set, i.e. protect the majority of blossom that is least protracted.
- Chemical fruit thinning to drop a crop is not considered a good option.
- Manage water in line with fruit size growth.
- Commence a replant program as soon as possible to avoid negative cash flow in future.
- Monitor and treat trees with collar rot and consider nematode control options of mature bearing trees if a major problem.
- The cost of applying organic and or plastic mulches in Australia may be to prohibitive compared to the benefits.
- Further research is required on anti-transpirants as research to date appears to be inconclusive.
- Have a clearly devised plan, be flexible and seek continued assistance as you will not be alone.

5. Dissemination of Information

A final report will be posted on the ACG website and put on CD for distribution to the industry. A copy of the report will also be sent to the National Citrus Liaison Committee responsible for coordinating a citrus drought strategy for the industry.

6. Itinerary

Sunday 15 August: Arrive Johannesburg

Monday 16 July 2007*:* Meet with Citrus Research International (CRI), Extension Manager, Northern region, Dr. Hennie Le Roux and researchers; Dr Sarel du Plessis from the Agricultural Research Institute and a consultant in the region, Chris Kellerman.

Tuesday 17 July 2007: Drive to Tzaneen. Meet with growers in the drought affected Letsitele region such as Hugo Endemann, consultant and Edward Vorster from Mahela Farms owner).

Wednesday 18 July 2007: Drive to Marble Hall and meet with Kobus de Kock, Production Manager and Tieman Ogterop, consultant for Schoeman Farms, the largest privately owned citrus estate in South Africa. Drive to Pretoria.

Thursday 19 July 2007: Meet with Dr. Hannes Coetzee, JGK Consulting, on nutrition and irrigation management. Fly to Port Elizabeth.

Friday 20 July 2007: Meet with Hannes Bester, CRI Extension Manager in the Southern region, Eric Holmden, consultant in the Eastern Cape, Robbie Childs, nutrition and irrigation consultant in the Eastern Cape and Hannes Joubert, private grower in the Eastern Cape.

Saturday 21 July 2007: Fly to Cape Town.

Sunday 22 July 2007: Cape Town-at leisure.

Monday 23 July 2007: Meet with Dr. Graham Barry, plant physiologist, University of Stellenbosch and Ballie Wahl, Extension Specialist, Capespan.

Tuesday 24 July 2007: Visit Citrusdal with Rian Briedenhann, consultant on nutrition and Dr. Etienne Rabe, plant physiologist, Sun Pacific, California, USA.

Wednesday 25 July 2007: Return to Australia.

7. Recommendations

1. Include the report findings in the drought guidelines for the Australian citrus industry so that best management practices can be implemented.
2. More research into the use of mulches and anti-transpirants should be considered.
3. As much information possible should be documented during the period of drought in Australia to ensure drought strategies can be implemented effectively and efficiently in future.

8. Contact List

Name	Position	Institution	Contact details
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