QUARTERLY REPORT

THE CALYPSO™ MANGO PROJECT

REPORT FOR OOLLOO FARM MANAGEMENT

Agronomic Assessment of Mataranka, Katherine, Darwin, and Dimbulah Farms - July 2010

Prepared by A.W. Whiley
Sunshine Horticultural Services Pty Ltd, Nambour

REPORT FOR OOLLOO FARM MANAGEMENT

Agronomic Assessment of the Calypso™ Mango Properties at Mataranka, Katherine, Dimbulah Managed by Oolloo Farm Management

CONTENTS

This report provides an overview of the current agronomic status following a visit to the Calypso™ Mango Project and OMC properties at Mataranka, Katherine, Darwin and Dimbulah. Visits were from the 5-8th July 2010.

Key issues

1. **At Mataranka band agricultural gypsum each side of the rows at 3 kg/tree before the end of July;**
2. **At Mataranka flower prune small trees after mid-August to prevent fruiting;**
3. **At Mataranka apply Octave/Mancozeb fungicide at peak flowering;**
4. **At K1 apply pre-flowering boron;**
5. **At K1 band agricultural gypsum each side of the rows at 3 kg/tree before the end of July;**
6. **At K1 apply Octave/Mancozeb fungicide at peak flowering;**
7. **At K2 flower prune small trees after mid-August to prevent fruiting;**
8. **At K2 apply Octave/Mancozeb fungicide at peak flowering;**
9. **At Dimbulah flower prune trees with fully expanded panicles ASAP (finish before the end of July);**
10. **At Dimbulah continue with mango scale control;**
11. **At Dimbulah flower prune small trees after mid-August to prevent fruiting.**

Introduction

The mid-winter farm visits provide the opportunity to assess how flowering is progressing in relation to crop estimates and uniformity of maturity. Flower development was occurring over all farms at the time of the visit and the consequences of this activity are contained in the body of the report. In addition, based on the potential flowering observed when visiting farms, the historic yield data and yield projection models, Indicative Yield Projections are given for each of the farms. These will require up-dating for each farm at the end of flowering since weather/pest events may disrupt the fruit setting event.

Mataranka 1 and 2 Farms – Mataranka NT (6th July 2010)

The Calypso™ Project orchard at Mataranka was visited on the 6th July 2010 in the company of Scott Bottem of Oolloo Farm Management.

1. Nutrition

Nutritionally speaking the trees looked in excellent condition for this time of year. Pre-flowering leaf analyses indicated that all essential nutrients with exception of zinc were in the optimum range for growth and production. Zinc is a difficult nutrient to manage on this farm due to poor uptake in the alkaline soil (pH in excess of 8.0). Foliar applications of LigZinc® when the trees are actively flushing through the wet season and autumn is the only effective technique of supplying requirements albeit the resulting levels are not as high as desired. During the visit it was noted that the gypsum bands (Fig. 1) had been leached out hence there is a requirement to reapply gypsum prior to the end of July at the rate of 3 kg/tree (1.5 kg/tree banded within the root zone each side of the rows). Calcium (from a gypsum source) plays an integral role in building cell strength of fruit and must be adequately available in the soil solution during the first 6 weeks of fruit development to maximise its role in postharvest quality.

Fig. 1 Recently banded gypsum.

2. Flowering

Flowering across the Mataranka Farms has triggered across all of the property with remarkable uniformity (Fig. 2). It was estimated that in excess of 95% of shoot terminals had initiated flowers which were at about 40% extension at the time of the visit. This is a great result for farm management as it will lead to a uniform maturity allowing strip picking of high quality fruit across the farm. The downside to this result is the short harvest season as the whole property will mature fruit almost simultaneously. Sufficient harvest aids, labour and subsequent downstream infrastructure will be necessary to move the crop in a 15-20 day window.

Fig. 2 A solid flowering result for Mataranka.

3. Irrigation

Since the April visit to the farm the electronic soil moisture monitoring equipment has been upgraded and is now operational. Additionally, drilling and connecting a new bore is proceeding and is expected to be completed prior to full water demand for the current season's crop. This will allow greater irrigation flexibility and will significantly reduce the risk of crop damage through the addition of an alternative water source.

The first six weeks after peak flowering is critical for fruit growth in relation to final size. Soil moisture should be maintained at 10 kPa or lower at 200 mm depth during this time.

4. On-farm Research

A. Flower Pruning to Delay Fruit Maturity

Flower pruning in some environments can be used to manage fruit maturity as when flowers that are no more than 50% extended are removed re-flowering at a later date will generally occur thereby shifting maturity backwards. The risk of using this procedure on the Mataranka Farms is that due to the short floral initiation window trees will either not re-flower or late flowering will result in small non-commercial fruit due to their development in extreme temperature conditions. To obtain data to test the de-flowering strategy on this farm 100 trees have been de-flowered and will be closely monitored over the forthcoming season. The time of peak flowering will be recorded independently to the remainder of the orchard and a Screen Duo® foliar program will be applied to 50 of the trees to encourage larger fruit.

B. Improving fruit size

The size of Calypso™ fruit from the southern NT farms is smaller than those grown in other production areas and is thought to be due to a combination of high yields and fruit development occurring under extreme high temperatures reducing day-time photosynthesis and precipitating excess carbon loss from the tree and fruit during day/night respiration. A reduction in carbon accumulation reduces the potential for tree and fruit growth. A new product known as Screen Duo® has properties that may reduce tree and fruit temperature and the associated stress and is worthy of on-farm research to evaluate its potential to increase fruit size.

For the Screen Duo® application select two blocks of trees located in different areas of the farm. Divide each block in two and only treat half of each block with Screen Duo®. At harvest keep track of the fruit from each block by assigning the half blocks as XA (for treated) and XB (for untreated). Apply Screen Duo® as per schedule attached to this report (Appendix 1).

5. Flower Prune Small Trees

Strong floral induction conditions have occurred across the Mataranka Farms with almost all trees irrespective of their size producing flowers. A small number of trees (generally replacements) are too small for cropping (Fig. 3) and continued vegetative growth should be encouraged. This is achieved by flower removal however if carried out too early it is likely to precipitate re-flowering of these trees. It is recommended that flower removal on small trees is not carried out before mid-August when vegetative regrowth will be encouraged.

Fig. 3 Small tree to be de-flowered to promote vegetative growth.

6. Pest Activity

Bob Sandry is continuing to supply IPM monitoring and advice services to the Mataranka farms. There were no pest issues at the time of the visit although populations of dimple bug had been detected. These will be controlled when significant commercial populations are detected.

The fungicides Octave®/Mancozeb® will be applied at peak flowering to reduce the risk of anthracnose infection.

7. Indicative Yield Projection (IYP)

The modelled IYP for the third year of cropping at Mataranka Farms is 39 kg/tree. Zones 1-4 are in their third cropping year while Zone 5 will enter its second cropping year where the modelled IYP is 29 kg/tree. In estimating the 2010 crop two factors need to be taken into account: 1) the strength of the flowering; 2) historic yield data for the farm. The February 2010 Farm Visit Report suggested that based on historic farm yields the IYP should be estimated at 85% of the modelled IYP for the respective years of production. However, the 2010 flowering has given such a strong and uniform result that for Zones 1-4 a figure of 90% of the modelled IYP (for third year cropping) is used as a basis for this estimation. **Hence based on July 2010 observations the 2010 IYP for the Mataranka Farms is estimated at 1680 tonnes total harvested crop which is 49% higher than the 2009 crop. This estimate will require confirmation at the time of fruit set.**

Oolloo Farm – Katherine, NT (7th July 2010)

The Calypso™ Project orchards known as Oolloo Farm (K1 & K2) were visited on the 7th July 2010 in the company of Mark Robertson and Ray Hook of Oolloo Farm Management.

K1

1. Nutrition

Pre-flowering leaf analyses indicated that all essential nutrients with exception of boron and zinc were in the optimum range for growth and production. Pre-flowering boron applied as Solubor® at the rate of 30 g/tree fertigated over the 12.5 m^2 area of sprinkler throw has been previously recommended to the farm manager. Zinc is a difficult nutrient to manage on this farm due to poor uptake in the alkaline soil (pH in excess of 8.0). Foliar applications of LigZinc® when the trees are actively flushing through the wet season and autumn is the only effective technique of supplying requirements albeit the resulting levels are not as high as desired. Similarly to the Mataranka Farms it was noted that the gypsum bands (Fig. 1) had been leached out hence there is a requirement to reapply gypsum prior to the end of July at the rate of 3 kg/tree (1.5 kg/tree banded within the root zone each side of the rows). Calcium (from a gypsum source) plays an integral role in building cell strength of fruit and must be adequately available in the soil solution during the first 6 weeks of fruit development to maximise its role in postharvest quality.

Young trees have been inter-planted between mature trees in some of the blocks on the K1 farm where it was judged that existing trees were growing too slowly to fill in orchard gaps. To keep these young trees growing strongly an independent fertiliser program is required which will have to be hand administered. The new trees should receive 50 g/month of Diamond 19 plus a clenched handful if Urea taking care to distribute the later evenly around the trees over the first 6 months. This should be increased to 100 g/6 weeks of Diamond 19 plus 50 g/six weeks of urea once trees have flushed and show signs of good growth (approximately 6 months after planting).

2. Flowering

The 2010 flowering at K1 is heavy and consistent across the property with remarkable uniformity (Fig. 2). It is estimated that in excess of 95% of shoot terminals have initiated flowers which were at about 40% extension at the time of the visit. This is a great result for farm management as it will lead to a uniform maturity allowing strip picking of high quality fruit across the farm. The downside to this result is the short harvest season as the whole property will mature fruit almost simultaneously. Sufficient harvest aids, labour and subsequent downstream infrastructure will be necessary to move the crop in a 15-20 day window.

Fig. 4 A strong flowering at K1 farm at Katherine, NT (July 2010).

3. Irrigation

The failed bore is to be re-cased and an existing bore recommissioned prior to the fruiting season. This will provide adequate water with sufficient back-up to reduce the risk of crop losses should bore/pump failures occur between flowering and harvest.

The first six weeks after peak flowering is critical for fruit growth in relation to final size. Soil moisture should be maintained at 10 kPa or lower at 200 mm during this time (the installation of three tensiometer stations to provide data for use with the electronic monitoring system is recommended).

4. On-farm Research

A. Flower Pruning to Delay Fruit Maturity

Flower pruning in some environments can be used to manage fruit maturity as when flowers that are no more than 50% extended are removed re-flowering at a later date will generally occur thereby shifting maturity backwards. The risk of using this procedure on the Katherine Farm is that due to the short floral initiation window, trees will either not re-flower or late flowering will result in small non-commercial fruit due to their development in extreme temperature conditions. To obtain data to test the de-flowering strategy on this farm 100 trees have been de-flowered and will be closely monitored over the forthcoming season. The time of peak flowering will be recorded independently to the remainder of the orchard and a Screen Duo® foliar program will be applied to 50 of the trees to encourage larger fruit.

B. Improving fruit size

The size of Calypso™ fruit from the southern NT farms is smaller than those grown in other production areas and is thought to be due to a combination of high yields and fruit development occurring under extreme high temperatures reducing day-time photosynthesis and precipitating excess carbon loss from the tree and fruit during day/night respiration. A reduction in carbon products reduces the potential for tree and fruit growth. A new product known as Screen Duo® has properties that may reduce tree and fruit temperature and the associated stress and is worthy of on-farm research to evaluate its potential to increase fruit size.

For the Screen Duo® application select two blocks of trees located in different areas of the farm. Divide each block in two and only treat half of each block with Screen Duo®. At harvest keep track of the fruit from each block by assigning the half blocks as Block XA (for treated) and Block XB (for untreated). Apply Screen Duo® as per schedule attached to this report (Appendix 1). Block 11 was identified as one of the potential blocks to use on this farm.

5. Flower Prune Small Trees

Strong floral induction conditions have occurred across the K1 farm with almost all trees irrespective of their size producing flowers. A number of trees (mostly the interplants) are too small for cropping and continued vegetative growth should be encouraged. This is achieved by flower removal however if carried out too early it is likely to precipitate re-flowering of these trees. It is recommended that flower removal on small trees is not carried out before mid-August when vegetative regrowth will be encouraged.

6. Replacement of Stunted Trees

It has been noted that a small percentage of trees on the farm are stunted due to growth rates far slower than the average population. In most instances these trees are easily identified due to the “crocodile bark cracking” seen on the rootstock (below the graft union) (Fig. 5) indicating that there is poor compatibility between the two genetically different components of the tree. These trees will never reach their true production potential and should be removed and replaced as soon as they can be identified.

Fig. 5 Calypso tree stunted by incompatibility (rootstock crocodile bark).

7. Pest Activity

Bob Sandry is continuing to supply IPM monitoring and advice services to the Katherine farms. There were no pest issues at the time of the visit although populations of dimple bug had been detected. These will be controlled when significant commercial populations are detected.

The fungicides Octave®/Mancozeb® will be applied at peak flowering to reduce the risk on anthracnose infection.

8. Indicative Yield Projection (IYP)

The modelled IYP for the fifth year of cropping at K1 is 57 kg/tree. In estimating the 2010 crop two factors need to be taken into account: 1) the strength of the flowering; 2) historic yield data for the farm. The February 2010 Farm Visit Report suggested that based on historic farm yields the IYP for Blocks 1-20 should be estimated at 85% of the modelled IYP for the respective years of production and for Blocks 21-22 75% of the modelled IYP. However, the 2010 flowering has given such a strong and uniform result that for Blocks 1-20 90% of the modelled IYP will be used to estimate the 2010 IYP and for Blocks 21-22 80% of the modelled IYP will be used as a basis for this estimation. **Hence based on July 2010 observations the 2010 IYP for the K1 Farm is estimated at 1373 tonnes total harvested crop which is 42% higher than the 2009 crop. This estimate will require confirmation at fruit set.**

K2

1. Nutrition

Tree health across the farm was good with leaf colour within the acceptable range. Pre-flowering leaf analyses indicated that all nutrients were within the commercially acceptable limits with the exception of boron and zinc. A pre-flowering recommendation for the application of boron as Solubor® at 15 g/tree fertigated over the 12.5 m^2 of sprinkler cover has been previously advised. Zinc is a difficult nutrient to manage on this farm due to poor uptake in the alkaline soil (pH in excess of 8.0). Foliar applications when the trees are actively flushing through the wet season and autumn is the only effective technique of supplying requirements albeit the resulting levels are not as high as desired.

2. Flowering

As with Mataranka and K1 farms there has been a strong and uniform flowering response across this farm. It is estimated that in excess of 95% of shoot terminals have initiated flowers which were at about 40% extension at the time of the visit. This is a great result for farm management as it will lead to a uniform maturity allowing strip picking of high quality fruit across the farm. The downside to this result is the short harvest season as the whole property will mature fruit almost simultaneously. Sufficient harvest aids, labour and subsequent downstream infrastructure will be necessary to move the crop in a 15-20 day window.

3. Irrigation

A conversion from diesel to electricity is planned for the K2 bore which will significantly reduce operational costs and allow greater flexibility in programming irrigation applications. Without a second bore there remains crop risk should a supply failure occur. Additional water security will be address when farm ownership is clarified.

The first six weeks after peak flowering is critical for fruit growth in relation to final size. Soil moisture should be maintained at 10 kPa or lower at 200 mm during this time (the installation of three tensiometer stations to provide data for use with the electronic monitoring system is recommended).

4. On-Farm Research

Improving fruit size

The size of Calypso™ fruit from the southern NT farms is smaller than those grown in other production and is thought to be due to a combination of high yields and fruit development occurring under extreme high temperatures reducing day-time photosynthesis and precipitating excess carbon loss from the tree and fruit during night respiration. A reduction in carbon products reduces the potential for tree and fruit growth. A new product known as Screen Duo® has properties that may reduce tree and fruit temperature and the associated stress and is worthy of on-farm research to evaluate its potential to increase fruit size.

For the Screen Duo® application select two blocks of trees located in different areas of the farm. Divide each block in two and only treat half of each block with Screen Duo®. At harvest keep track of the fruit from each block by assigning the half blocks as Block XA (for treated) and Block XB (for untreated). Apply Screen Duo® as per schedule attached to this report (Appendix 1). Block 11 was identified as one of the potential blocks to use on this farm.

5. Flower Prune Small Trees

Strong floral induction conditions have occurred across the K2 farm with almost all trees irrespective of their size producing flowers. A number of trees are too small for cropping (Fig. 6) and continued vegetative growth should be encouraged. This is achieved by flower removal however if carried out too early it is likely to precipitate re-flowering of these trees. It is recommended that flower removal on small trees is not carried out before mid-August when vegetative regrowth will be encouraged.

Fig. 6 Small trees on K1 that require de-flowering.

6. Pest activity

Bob Sandry is continuing to supply IPM monitoring and advice services to the Katherine farms. There were no pest issues at the time of the visit although populations of dimple bug had been detected. These will be controlled when significant commercial populations are detected.

The fungicides Octave®/Mancozeb® will be applied at peak flowering to reduce the risk on anthracnose infection.

7. Indicative Yield projection (IYP)

The modelled IYP for the second year of cropping at K2 is 29 kg/tree. In estimating the 2010 crop three factors need to be taken into account: 1) the strength of the flowering; 2) historic yield data for the farm; 3) the preceding summer growth. The February 2010 Farm Visit Report suggested that based on historic farm yields the IYP for K2 should be estimated at 75% of the modelled IYP. Despite the 2010 flowering being strong and uniform across the farm tree growth during the preceding summer months fell short of expectations so the yield factor will be downgraded to 65% of the modelled IYP. **Hence based on July 2010 observations the 2010 IYP for the K2 Farm is estimated at 663 tonnes total harvested crop which is 116% higher than the 2009 crop. This estimate will require confirmation at fruit set.**

Dimbulah Farms, NQ (5th July 2010)

The Calypso™ Project farm at Dimbulah was visited on the 5th July 2010 and the farm inspected with the manager Mark Letcher of Oolloo Farm Management.

1. Nutrition

Pre-flowering leaf analysis indicated that for the most part nutrient concentrations were within the normal range for optimum cropping. However, there were some blocks where leaf N levels were at the bottom of the acceptable range for this time of year. These include blocks 3, 5, 6, 8, 9, 10, 11, 12, 14, 17, 21, 52 & 53. Since trees in the majority of these blocks significantly yellowed after flowering in 2009 it is recommended that 1.5 g elemental N/m^2 of sprinkler throw (65 g of Urea) be applied as the flowers are growing out.

Phosphate leaf levels indicated adequate supply however an application of 150 kg/ha is recommended as a maintenance application.

2. Flowering

For the most part flowering had not significantly progressed across the farm at the time of the visit although sap exudates could be seen from expanding terminal buds on most of the trees indicating that flower-break was imminent. This condition was consistent across all blocks suggesting that a relatively uniform flowering will occur. However, 91% of the blocks had fully extended flowers (Fig. 7) on some trees, generally less than 10% of the block population. There is a high risk in relation to fruit set and retention having advanced flowering on mango trees in Dimbulah in early July as this is the coldest month of the year when minimum temperatures fall below 10°C and often to less than 5°C. Under such conditions opened flowers will be chill-damaged and embryos in fruitlets will abort producing nubbins of no commercial value. It is recommended that all fully expanded flowers be pruned from the trees ASAP with completion by the 24th July. This will allow re-flowering of these trees with the opportunity to set and retain fruit through to maturity thus ensuring greater synchronisation of trees across blocks in the future.

Fig. 7 Fully expanded flowers at Dimbulah Farms in July 2010.

It was also noted at the time of the visit that those blocks treated with PBZ in 2009 had greater synchronisation of flowering (4.3% of trees with fully expanded flowers) than blocks that were not PBZ treated (14.0% of trees with fully expanded flowers). In 2010 all blocks have been treated and together with the current flower pruning this should lead to great synchronisation of flowering in the future.

3. Irrigation

The Environscan water monitoring system has been repaired and will be operational for the fruiting season.

The first six weeks after peak flowering is critical for fruit growth in relation to final size. Soil moisture should be maintained at 10 kPa or lower at 200 mm during this time (the installation of three tensiometer stations to provide data for use with the electronic monitoring system is recommended).

4. Flower Prune Small Trees

A number of trees are still too small for cropping and continued vegetative growth should be encouraged. This is achieved by flower removal however if carried out too early it is likely to precipitate re-flowering of these trees. It is recommended that flower removal on small trees is not carried out before mid-August when vegetative regrowth will be encouraged.

5. Pest activity

Several pesticides have been used to evaluate the control of mango scale on the Dimbulah Farms. At the time of the visit Supracide® (methidathion) had given the best control of the products tested. The Supracide label stipulates that the product is not to be used with oil or when fruit is on the tree.

6. Indicative Yield Projection (IYP)

The modelled IYP for the third year of cropping at Dimbulah is 27 kg/tree. In estimating the 2010 crop three factors need to be taken into account: 1) the strength of the flowering; 2) historic yield data for the farm; 3) the preceding summer growth. The February 2010 Farm Visit Report suggested that based on historic farm yields the IYP for Dimbulah Farms should be estimated at 55% of the modelled IYP. Despite the 2010 flowering being strong and uniform across the farm tree growth during the preceding summer months fell short of expectations. **Hence based on July 2010 observations the 2010 IYP for the Dimbulah Farms is estimated at 899 tonnes total harvested crop which is 43% higher than the 2009 crop. This estimate will require confirmation at fruit set.**

Appendix 1

Use of Screen Duo® to Improve Fruit Size

Screen Duo® is a kaolin-based product marketed in Australia by Agricrop (Stewart Frankling 0447558219) for the protection of horticultural crops against excessive heat and sunburn damage. The product is relatively new to the market and there is little information available on its performance on mangoes. For the 2010 fruiting season product is available though Landmark and Muirs outlets in the NT. The following experimental protocols are proposed to test the efficacy of Screen Duo® on 'B74' mango.

Site: OFM at K1&K2 (Katherine) and M1 (Mataranka))

Objectives: In the two cropping seasons so far experienced with 'B74' mangoes the average fruit size has been below the national average for the variety. This has led to some difficulties in marketing the entire crop at acceptable returns. The reduced fruit size is likely due to reduced cell division in fruit due to a short time between fruit-set and the rapid increase in daily maximum temperatures. Once temperatures exceed 35°C photo-inhibition occurs and mango trees fix reduced levels of atmospheric carbon essential fruit growth. Research with other crops has shown that Screen Duo® can reduce leaf temperature by as much as 10°C thereby maintaining photosynthetic activity for longer daily periods. In addition to smaller fruit size Katherine and Mataranka-grown 'B74' is prone to fruit malformation and sunburn damage due to high ambient temperatures and radiation levels. The evaluation of Screen Duo® on other crops has shown that the product can significantly reduce the damaging effects of high temperatures and radiation on fruit thereby improving overall fruit quality. The purpose of this proposed experiment is to evaluate at a semi-commercial level the effect of Screen Duo® on fruit size and sun damage to 'B74' fruit. Effective removal of the product at the packing shed will also be assessed.

Plot size: The Screen Duo® treatment will be applied to a plot which will consist of a full block of trees on the K1&K2 and M1 farms.

Treatments:

1. Control – standard OFM management practice with no Screen Duo® applied.
2. Screen Duo® applied immediately after the termination of flowering (fruitlets no larger than pea size). For this treatment Screen Duo® will be applied on a regular basis through to harvest. The 1st application will be of a 2.5% formulation followed at 7 day intervals with a 1.25% formulation through to stone-hardening (6 weekly applications). Following this period subsequent applications will be at 14-21 day intervals (depending on rainfall) using a 1.25 % application. Screen Duo® is to be applied with Du-Wett®. **This treatment is to test the effect of Screen® on improving fruit size**

Note: the manufacturing and marketing companies believe that Screen® is compatible with most fungicides and pesticides used on horticultural crops. For a list of compatible products refer to the product brochure.

Data to be collected: Most data will be collected at the pack-house. However, the longer applied treatments may change crop characteristics that will need to be assessed in the field. Pertinent data required are:

1. Maturity dates for blocks. Cooler tree temperatures may either advance or retard fruit maturity. If heat stress is a major limiting factor at this site then it is expected that maturity in treatment 2 will be advanced.
2. Block biological yield (the total weight of fruit harvested off each block).
3. Block pack out percentages (commercial yield).
4. Reject fruit analysis of each block (in particular a break-down into rejection caused by fruit malformation and sunburn).
5. Fruit quality assessments – cosmetic rated as mature green packs and ripened packs. In particular blush colour needs to be assessed to determine that there has been no reduction by treatment.