



SLV Comiskey
Agribusiness Consulting

FINAL REPORT

Scheduling Banana Production after Tropical Cyclones

for:

Australian Banana Growers Council

prepared by:

**Stewart Lindsay, Senior Development Horticulturist,
Queensland Department of Agriculture, Forestry &
Fisheries**

Shane Comiskey, Agribusiness Consultant, SLV Comiskey

December, 2012

TABLE OF CONTENTS

1	Executive Summary	9
2	Introduction.....	12
2.1	Introduction.....	12
3	Purpose and Objectives	15
4	Methodology.....	16
4.1	Agronomic Assessments.....	16
4.1.1	Pre-cyclone management strategies – canopy removal.....	16
4.1.2	Post-cyclone management strategies – staggered cropping program to return to cropping	17
4.2	Productive and Financial Assessments	18
4.2.1	DAFF Supplied Data	18
4.2.2	Grower Sourced Data	19
4.2.3	Industry Sourced Data	19
4.2.4	Model Development	20
5	Results	21
5.1	Agronomic assessments.....	21
5.1.1	Pre-cyclone management strategies – canopy removal.....	21
5.1.2	Post-cyclone management strategies – staggered cropping program to return to cropping	22
5.2	Productive and Economic Assessments.....	31
5.2.1	Impact of TC Larry & Yasi on banana production – 2006 to 2012.....	31
5.2.2	Relationship between banana grower returns and delivery volumes	33
5.2.3	Average breakeven returns compared with weighted average net prices received – 2011 and 2012	36
5.2.4	Average net sales return per carton by crop management type.....	37
5.2.5	Average net sales revenue per hectare by crop management type	39
5.2.6	Fruit size distribution of different crop management types	40
5.2.7	Crop yields per hectare of different crop management types	41
5.2.8	Factors impacting variations in costs of production per hectare.....	41
6	Discussion.....	44
6.1	Agronomic assessments.....	44

Scheduling Banana Production After Tropical Cyclones

6.1.1	Pre-cyclone management strategies – canopy removal	44
6.1.2	Post-cyclone management strategies – staggered cropping program to return to cropping	45
6.2	Productive and Economic Assessments	47
6.2.1	Introduction.....	47
6.2.2	Pre-cyclone management strategies – canopy removal	47
6.2.3	Post-cyclone management strategies – staggered cropping program to return to cropping	48
6.2.4	Project Summary.....	49
7	Extension and communication	51
8	Future Recommendations	52
8.1	Database of Crop Production Schedules	52
8.2	Further Communication.....	52
9	Acknowledgements	53
10	Photo Library	54

LIST OF TABLES

Table 1: Effect of canopy removal on plant characteristics.	21
Table 2: Effect of canopy removal on bunch characteristics.	21
Table 3: Percentage harvest distribution for staggered cropping trial at DAFF Queensland South Johnstone Research Station.	23
Table 4: TC Yasi crop cycle (CR1) characteristics for staggered cropping trial at DAFF Queensland South Johnstone Research Station.	24
Table 5: May “nurse-sucker” crop cycle (CR2) characteristics for staggered cropping trial at DAFF Queensland South Johnstone Research Station.	25
Table 6: August “nurse sucker” crop cycle (CR3) characteristics for staggered cropping trial at DAFF Queensland South Johnstone Research Station.	25
Table 7: October “nurse sucker” crop cycle (CR4) characteristics for staggered cropping trial at DAFF Queensland South Johnstone Research Station.	26

LIST OF FIGURES

Figure 1: Track Maps for cyclones within 50km of Tully from 1996 to 2006.....	12
Figure 2: Spread of harvest for farms replanted end April, 2011 (ToP3).....	27
Figure 3: Spread of harvest for farms replanted end July, 2011 (ToP4)	27
Figure 4: Spread of harvest for farms replanted mid October, 2011 (ToP5)	28
Figure 5: Spread of harvest for farms with no crop intervention after Cyclone Yasi (CR1)	28
Figure 6: Spread of harvest for farms nurse suckered early May, 2011 (CR2)	29
Figure 7: Spread of harvest for farms nurse suckered early August, 2011 (CR3).....	29
Figure 8: Spread of harvest for farms nurse suckered 2nd week , 2011 (CR4)	30
Figure 9: Spread of Harvest for farms with no crop intervention after TC Yasi (CR1) - 2nd cycle*	30
Figure 10: Total number of cartons delivered by North Queensland banana growers – 2006 to 2012	32
Figure 11: Total North Queensland Delivery Volumes Wk 46-Wk 14, 2006/07 to 2011/12.	33
Figure 12: Average net sales returns & total North Queensland delivery volumes (Wk 28 – 2011 to Week 43, 2012)	34
Figure 13: Average net sales return for XL bananas of selected growers & industry sales reports (Wk 21 - 2011 to Wk 43 - 2012)	35
Figure 14: Average net sales return for Large bananas of selected growers & industry sales reports (Wk 21 - 2011 to Wk 43 - 2012)	35
Figure 15: Average net sales return & average net breakeven price (Wk 28 - 2011 to Wk 43 - 2012)	37
Figure 16: Average net sales return per carton by crop management type	38
Figure 17: Total net sales revenue per hectare by crop management type, 2011 & 2012.....	39
Figure 18: Fruit size distribution of different crop management types.....	40
Figure 19: Number of cartons packed per hectare x pack type for different crop management types	41
Figure 20: Average net profit per hectare before tax by crop management type	42
Figure 21: \$ gain in net profit before tax per hectare by crop management type compared to CR1...	43
Figure 22: Comparison of the harvest dynamics for the staggered cropping program with the unmanaged cyclone crop cycle.....	46
Figure 23: Uniform April planting (ToP3) at South Johnstone Research Station	54
Figure 24: New sucker growth on nurse suckered plant at South Johnstone Research Station.....	55
Figure 25: Canopy removal in part of block in Innisfail district – note treated plants on right hand side compared to untreated plants on left hand side.....	56
Figure 26: Grower shed meeting Innisfail district outlining staggered cropping proposal, April 2011. 56	

Scheduling Banana Production After Tropical Cyclones

Figure 27: Grower meeting at DAFF South Johnstone Research Office outlining staggered cropping proposal, April 2011	57
Figure 28: Grower meeting at DAFF South Johnstone Research Office outlining staggered cropping proposal, April 2011	57
Figure 29: CR2 equivalent block on a commercial farm in Innisfail region, June 2012.....	58
Figure 30: Trial plant ready for harvest in CR1 plot in staggered cropping trial	59
Figure 31: Canopy removal treatment applied to trial plants at South Johnstone Research Station.	60
Figure 32: Canopy removal trial bunch harvest and measurement at South Johnstone Research Station.	61
Figure 33: Typical bunch characteristics (small bunch size and fruit) where canopy removal occurred after bunch initiation	62
Figure 34: Canopy removal treatment in Innisfail district – banana plant where the vegetative bud has died soon after TC Yasi.....	63
Figure 35: Plants on Tully Farm one week after TC Yasi without canopy removal	64
Figure 36: Canopy removal block in Tully one week after TC Yasi	65
Figure 37: Canopy removal block in Innisfail one week after TC Yasi	65
Figure 38: Grower Field Day in staggered crop trial at South Johnstone Research Station, November 2012.	66
Figure 39: Early canopy removal trial. Bunch immediately prior to harvest.....	67
Figure 40: South Johnstone Research Station Trial Plot immediately after TC Yasi	67
Figure 41: Canopy removal trial plot at DAFF South Johnstone Research Station.....	68

Scheduling Banana Production After Tropical Cyclones

DEFINITIONS

Term	Definition
Business expenses	Costs incurred in the operation of the business that are not directly related to the volume of production of bananas eg. insurance, repairs & maintenance.
Cost of goods sold (COGS)	Costs incurred (on-farm and off-farm) that are directly related to the volume of production of bananas.
Gross profit	Total income less COGS.
Gross profit margin	Gross profit divided by total income expressed as a %.
Net banana sales	Total banana sales <u>less</u> marketing fees and commissions + ripening and handling fees + levies
Average banana sales per carton or net return per carton	Total banana net sales (after marketing fees & commission, ripening fees and levies) divided by the total number of cartons produced.
Net profit	Gross profit less business expenses or total income less COGS and expenses.
Net profit margin	Net profit divided by total income expressed as a %.

Scheduling Banana Production After Tropical Cyclones

SUMMARY OF CROP MANAGEMENT TECHNIQUES ASSESSED

Crop Management Abbreviation	Crop Management Details
CR1	Farm with no crop intervention after cyclone (CR1)
ToP3	Farm replanted end April, 2010 (ToP3)
ToP4	Farm replanted end July, 2010 (ToP4)
ToP5	Farm replanted end October, 2010 (ToP5)
Pre-BI	Farm with canopy removal prior to cyclone (pre-bunch initiation) (Pre-BI)
Post-BI	Farm with canopy removal prior to cyclone (post-bunch initiation) (Post-BI)
CR2	Farm nurse suckered 1st week May, 2011 (CR2)
CR3	Farm nurse suckered 1st week August, 2011 (CR3)
CR4	Farm nurse suckered 2nd week October, 2011 (CR4)
CR1(2)	Farm with no crop intervention after cyclone (CR1)(2)

DISCLAIMER

The Queensland Department of Agriculture Forestry and Fisheries (“DAFF”) and SLV Comiskey (“Comiskey”) has been retained by the Australian Banana Growers Council (“ABGC”).

You should be aware that the preparation of this report has necessitated projections as to the future that are inherently uncertain and our opinion is based on the underlying representations and assumptions detailed in this report. There may be differences between projected and actual results because events and circumstances may not occur as anticipated, and those differences may be material. We cannot express an opinion as to whether actual results will approximate projected results, nor can we confirm, underwrite or guarantee the achievability of the projections based on assumptions regarding future events. DAFF or Comiskey are not liable, whether in tort, contract or otherwise, for any loss, damage or consequential loss suffered by the ABGC or others caused by reliance on this report.

Finally, we advise that no part of our report may be included in any document, prospectus, circular or document to a third party without the written approval of DAFF, Comiskey or ABGC.

This report can only be regarded as relevant as at the date of its issue, being December 2012.

1 EXECUTIVE SUMMARY

Severe Tropical Cyclone Yasi crossed the north Queensland coast in the Mission Beach/Tully in early February 2011 and caused widespread infrastructure damage and agricultural crop loss. The wet tropical coast region of north Queensland, based around the towns of Tully and Innisfail, produces approximately 90% of the Australian banana crop. The size and intensity of TC Yasi meant that the impact on the Australian banana industry was catastrophic with a near 100% destruction of the crop in the coastal production regions. The financial and social impacts on the region were significant, especially coming only five years after similar regional damage caused by Severe Tropical Cyclone Larry that crossed the coast at Innisfail in March 2006.

Previous severe, industry-wide tropical cyclone damage from Severe Tropical Cyclone Winifred (February 1986) caused an industry-wide synchronisation of cropping that resulted in 12 months' fruit production being harvested in only a three to four month period, followed by a period of distinct undersupply and then another concentration of harvest 9-11 months after the first overproduction cycle. The result from this cyclone-induced cropping pattern for producers and consumers is distinct cycles of over- and undersupply for up to two years after the original impact.

Based on the experience of this cyclone-induced cropping pattern in 1986-88 the ABGC and Queensland Department of Primary Industries ("QDPI"), now DAFF, developed a suggested staggered cropping program for banana growers drawing on lessons from TC Winifred (in 1986). The program was promoted to growers in the aftermath of TC Larry but adoption levels were not sufficient to avoid significant periods of over and undersupply.

With the impact of TC Yasi so soon after the TC Larry experience the ABGC and DAFF Qld again developed information about crop management practices to avoid the cyclone-induced cropping cycle. With funding support from the Rural Resilience Program the ABGC commissioned a project to investigate both pre- and post-cyclone management practices to mitigate the impacts of cyclone damage. A key component of the project was the development of comprehensive economic modelling of the different practices so that banana producers could evaluate the impact of adoption or non-adoption of the various practices.

The main pre-cyclone crop management practice focused on maintenance of production units and an earlier return to fruit production by partially or completely removing the plant canopy to reduce wind resistance prior to the cyclone. A field trial at DAFF Qld South Johnstone Research Station investigated the impact of canopy removal on plants at different stages of development on plant growth, yield and fruit characteristics. The results showed that canopy removal reduced overall bunch weights by 40-50% regardless of the stage of plant development. However, removing the canopy from trees that had not yet started the bunch initiation and development phase resulted in a significantly higher proportion of fruit from each bunch in the optimum size category of 220-260 mm long compared to plants where canopy removal occurred after bunch initiation and development had already occurred. Data collected from this trial was used in the development of the economic modelling.

The post-cyclone crop management practice focused on the use of nurse suckering and replanting of crops to provide a more continuous even supply of bananas once production had recommenced. A second field trial at South Johnstone compared crop timing, yields and fruit length characteristics of the suggested staggered

cropping program with the cyclone-induced cropping cycle. The trial results demonstrated that not intervening in the cyclone cropping cycle produced a significant proportion of the total crop (43%) in the period Oct 2011-Mar 2012 compared to 25% for the staggered cropping program for the same period. The staggered cropping program also increased the proportion of fruit harvested, 47% of the total crop, in the period from Mar-July 2012 compared to only 11% of the total harvest from the cyclone induced crop cycle.

The primary focus of the economic assessment was to identify whether growers are better off financially to undertake any crop management practices after a cyclone or not. Further, if a grower can benefit from undertaking different crop management practices, what is the quantum of this benefit and what are the non-economic factors that a grower must consider when assessing what crop management strategy they may adopt immediately prior to and after a major cyclonic event.

The key findings from the economic assessment are:

1. Canopy removal trials generated very significant net profits per hectare compared with the other treatments of \$35,734 (post-bunch initiation) and \$70,191 (pre-bunch initiation). Growers however should be aware that there is a risk associated with significant canopy removal. If the cyclone does not impact a grower's crop or the cyclone does not have a significant or any impact on the growing region, the grower will be without any income for around 5-7 months and the crop volumes per hectare will be low impacting costs.
2. The cyclone induced crop cycle (CR1 treatment or "do nothing approach") generated a modest net profit (before tax) per hectare of \$4,073. This was the worst net profit result of all of the treatments tested.
3. Following TC Yasi, the average grower who undertook any one of the assessed crop management strategies would have benefited financially by a minimum of \$9,703 per hectare. This represents an increase of approximately 20-25% on average farm revenues.

The consultants wish however to point out to growers the following in respect of this analysis:

1. The figures presented are 'average' ones. Individual growers will benefit (or not) at different rates depending on their costs of production, block productivity and marketing skills. This study now has a modelling tool which can be used by all growers (possibly with assistance) to 'quickly' assess either just before or just after a cyclonic event the financial impacts of potential scenarios.
2. TC Yasi and TC Larry were severe cyclones which impacted a significant percentage of total NQ (and Australian banana production). The financial benefits associated with undertaking staggered crop management strategies will be lessened where cyclones have less of an impact on total industry production. Production in non-CR1 time slots will be better maintained by non-cyclone impacted growers thus reducing the potential financial benefit.
3. As growers shift more and more production away from the "do nothing approach / CR1", the financial benefits from undertaking these strategies are expected to be less as production becomes more even. Determining a more

accurate of the 'ideal' production mix is not feasible given the high number of variables that exist (degree of cyclone impact, timing of cyclone, variations in individual business performance etc.). Certainly a crop management mix such as presented in Figure 22 would result in an improved consistency of delivery of bananas to consumers.

4. The second cycle of "do nothing / CR1" bananas commenced in September and hit high levels in late October / November. This has forced a downward movement in prices received. Therefore the authors are able to conclude that the quantum of price benefits from undertaking various crop management strategies after TC Yasi is not just limited to one cropping event, but is expected to occur for 2 to 3 cropping events until production from each cycles starts to become spread and overlap.

2 INTRODUCTION

2.1 INTRODUCTION

The Queensland banana industry is valued around \$400M annually and supplies 90% of the Australian market. The key production region is based on the north-eastern tropical coast between latitudes 16-18°S, from Cardwell to Innisfail and the Atherton Tableland. These regions can experience tropical cyclone activity during the summer months. Severe tropical cyclone damage results in significant economic and social impacts on the north Queensland region and significant interruption to banana supplies for Australian consumers.

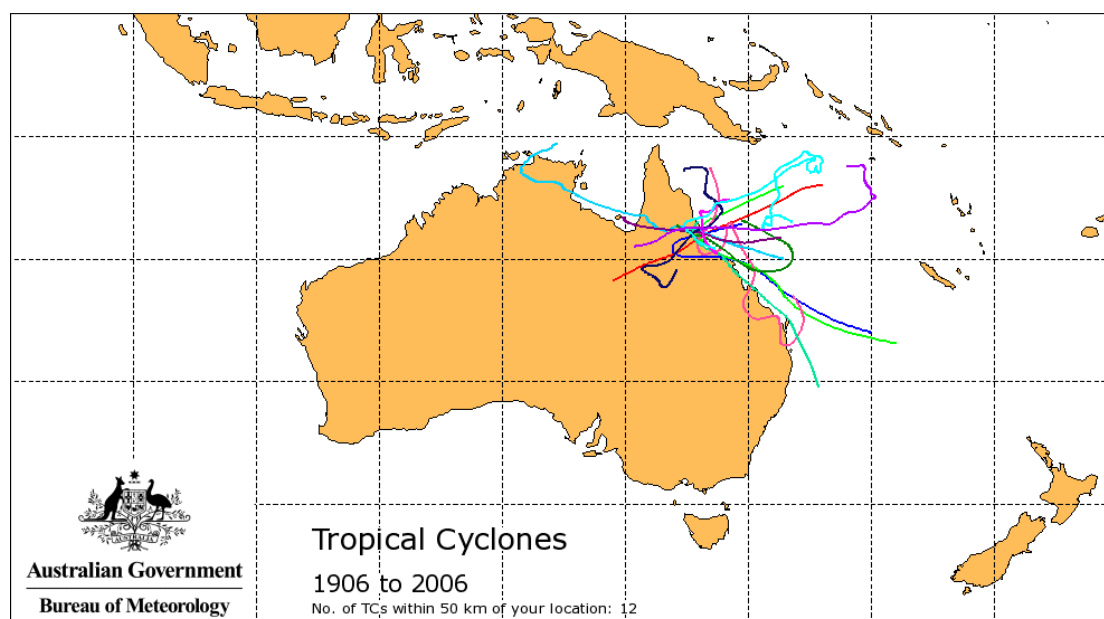
The majority of Australian banana production occurs on the north-eastern tropical coast between latitudes 16-18°S, and can experience tropical cyclone activity during the summer months. Damage from severe tropical cyclones has a significant impact on the livelihoods of banana producers and the associated farm labour, service industries and supply chains, including consumers.

The most significant impacts are the immediate loss of production and income for up to nine months, the region-wide synchronisation of cropping, the expense of recovering or replanting affected plantations, and flow on impacts to labour employment in the region.

The Australian Bureau of Meteorology (“BOM”) report that 12 cyclones have come within a 50km radius of Tully in the 101 year period from 1906 to 2006. Not all of these cyclones have been severe, in some cases their impact is quite localised, but in all instances cyclones do have an impact on the regions where the cyclone strikes.

The BOM data indicates (see Figure 1) that a cyclone will impact a region within a 50km radius of Tully, which encompasses the vast majority of the North Queensland banana industry (but excludes the Atherton Tableland) every eight to nine years.

Figure 1: Track Maps for cyclones within 50km of Tully from 1996 to 2006.



Source: Australian Bureau of Meteorology

Scheduling Banana Production After Tropical Cyclones

Two severe tropical cyclones have 'hit' the main production region twice in recent years – Tropical Cyclone ("TC") Larry (Category 4) in March 2006 and TC cyclone Yasi (Category 5) in February 2011.

Previous severe, industry-wide tropical cyclone damage (TC Winifred and TC Larry) caused an industry-wide synchronisation of cropping that resulted in 12 months' fruit production being harvested in only a three to four month period, followed by a period of distinct undersupply and then another concentration of harvest 9-11 months after the first overproduction cycle. The result for producers and consumers is distinct cycles of over- and undersupply for upwards of three cyclones after the cyclone.

In the aftermath of TC Larry the ABGC and Queensland Department of Primary Industries ("QDPI"), now DAFF, developed a suggested staggering cropping program for banana growers drawing on lessons from TC Winifred (in 1986). The program was promoted to growers at a series of grower focused meetings in April 2006

However following TC Larry, a large percentage of the total banana area was left to grow back without any crop timing management practices employed. This resultant price and supply impacts for the industry were:

- Very low supply from late March 2006 to the first week of January, 2007 with very high wholesale prices. However only those growers who were not impacted by the cyclone were able to benefit from the high prices (e.g. Kennedy).
- Extremely high supply volumes from early January 2007 to March 2007 resulting in growers who did not employ crop management practices receiving prices well below the cost of production.
- A number of cycles of high supply periods / low prices corresponding to this period without crop management. Over time the 'strength' of these cycles reduced as production spread out naturally.
- Consumers faced with high price volatility for upwards of two years, resulting in demand fluctuations as consumers who were 'turned off' by high prices taking time to 'come back' to being regular banana consumers. This situation further added to price and demand volatility.

Based on experiences with the aftermath of TC Larry both pre- and post-cyclone, farm practices to reduce these impacts were tested by banana producers in the aftermath of TC Yasi.

Factors given identified about why growers did not practice canopy management strategies (pre- or post-cyclone) after Cyclone Larry included:

- Lack of available resources (human or capital) to complete canopy management;
- Grower apathy;
- Growers attitude to risk (as it relates to canopy management);
- Limited knowledge about the correct canopy management methodologies to use; and,

- Limited knowledge of the financial benefits / disadvantage and cropping impacts of undertaking different crop management strategies.

With TC Yasi occurring only five years after TC Larry, industry believed that growers would remember the disastrous impacts the lack of adoption of canopy management had on industry. The very low prices and high supply volumes during late October 2011 to early January 2012 period were evidence that on an industry basis, crop management strategy adoption was still unacceptably low.

The main pre-cyclone crop management practice focused on maintenance of production units and an earlier return to fruit production by partially or completely removing the plant canopy to reduce wind resistance. Growers have limited ability to perform pre-cyclone crop management due to the limited time window available, as growers need to be convinced that the cyclone is going to hit, before undertaking this drastic crop management operation. Anecdotally, even though Cyclone Yasi tracked towards the destination up to a week before crossing the coast, growers who did perform pre-cyclone crop management did so for only 1 or 2 days before being forced to stand down workers. Traditionally however cyclones are much more unpredictable and so the 'window of opportunity' will typically be even shorter than this.

Post-cyclone crop management at the farm level focused on the use of nurse suckering and replanting of crops to provide a more continuous even supply of bananas. The hope by industry was that if enough growers practiced a variety of crop management practices that the industry return to supply continuity would be achieved more quickly. The benefits of supply continuity being more sustainable demand from consumers as they make bananas a 'staple' again as prices stabilise, which in turn provides for more even pricing for growers.

Following TC Yasi in 2011, industry sought to quantitatively assess the impact on supply volumes, time periods and economic performances of various crop management strategies through the development of a research trial at DAFF Queensland's South Johnstone Research Trial Station. Further, some banana producers implemented similar crop management practices to the research trial enhancing the accuracy of the results to be discussed in this report.

This project has undertaken research and development activities to refine our understanding of the effectiveness and economic impact of these practices and improve their application for future cyclonic events.

3 PURPOSE AND OBJECTIVES

The purpose of this project was to identify strategies that growers (and industry) may be able to adopt to more quickly return to improved levels of supply continuity to Australian consumers following major cyclonic events.

Therefore the key objectives of the study are:

1. Provide financial and agronomic assessments of different pre- and post-cyclone crop management practices in use by banana growers.
2. Using the data provided from (1) provide a series of industry recommendations that, if adopted, will reduce the impact of tropical cyclones on the livelihoods of Queensland, and by extrapolation, the Australia banana industry.

To achieve these objectives two agronomic field trials were undertaken to investigate the impact of different management practices on mitigating the effects of cyclone damage on banana production. Using information from these trials and from actual farm records supplied by banana growers, an economic assessment has been conducted of the impact of different crop management practices that growers may adopt following a cyclone.

The primary focus of the economic assessment is to identify whether growers are better off financially to undertake any crop management practices after a cyclone or not. Further, if a grower can benefit from undertaking different crop management practices, what is the quantum of this benefit and what are the non-economic factors that a grower must consider when assessing what crop management strategy they may adopt immediately prior to and after a major cyclonic event.

4 METHODOLOGY

4.1 AGRONOMIC ASSESSMENTS

4.1.1 Pre-cyclone management strategies – canopy removal

In the aftermath of TC Larry in 2006 many producers had to replant a high proportion of paddocks due to very high levels of “roll out” – where the banana plants had been blown out of the ground rather than snapped or bent in the pseudostem. Paddocks affected like this are largely uneconomic because of the lost production units, therefore necessitating the significant expense of eradicating and then replanting the blocks. So when TC Yasi threatened the banana industry in 2011, a small number of banana growers removed the leaf canopy on selected blocks. The idea was to reduce the plant’s wind resistance and therefore avoid the level of “roll out” plants experienced in 2006 with TC Larry.

Some banana producers implemented canopy removal prior to Cyclone Yasi and successfully prevented plant rollout. The canopy removal implemented by growers mainly took the form of either cutting through the pseudostem below the last leaf or removing the leaves by cutting through the leaf peduncle close to the pseudostem and then cutting through the pseudostem just below the youngest fully emerged leaf. The second method provided a stronger pseudostem when these plants subsequently produced a bunch.

In some instances a small proportion of the cut plants died before reshooting. However the majority of plants resumed leaf production and eventually produced a bunch well in advance of the suckers on plants with broken or kinked pseudostems. Reports and observations from commercial farms that implemented canopy removal indicated that bunch size and finger length characteristics were variable and the first bunches harvested from these plants had low yields of very short fruit. In many instances the first harvests yielded a carton/bunch ratio of 0.3 compared with normal standards between 1.4-1.7.

This research trial investigated the cause of the variability in bunch size and fruit length. Previous research on banana growth and development pointed to the stage of plant development at the time of canopy removal as the main contributor to the variation in bunch yield and fruit length that was observed.

Banana growth and development can be described in three stages:

1. Early vegetative – early in the life of the plant or sucker when the main bud at the centre of the base of the pseudostem is producing leaves.
2. Late vegetative – during this stage the main bud changes from vegetative to reproductive and the bunch is developing inside the pseudostem. Once the bunch is initiated there are only 11 leaves remaining within the pseudostem to emerge.
3. Reproductive – begins when the bunch emerges from the plant, and includes the fruit development period to harvest.

The theory being tested in this trial was that the removal of the leaf canopy relative to the time of bunch initiation would influence the capacity of the plant to produce hands of fruit, and limit the lengthening of fruit. However, there are no reliable visual external cues to indicate when bunch initiation has begun, so the application of the

canopy removal treatments was based on leaf counts as a measure of plant development. This approach was based on significant leaf count data from previous trials that indicated the typical total leaf number produced should be in the range of 29 to 31 leaves prior to bunch emergence. Using the figure of 11 leaves remaining to emerge at the time of bunch initiation, the timing of bunch initiation was assumed to coincide with the production of 19-20 leaves.

At South Johnstone Research Station a plot of 75 banana plants was “nurse-suckered” in July 2011 to start the next crop cycle with a high degree of uniformity so that each of four treatments could be randomly assigned to 15 uniform individual plants. Based on the assumptions mentioned above leaf counts for each plant were conducted at weekly intervals and the following treatments applied when the plant achieved the appropriate leaf count:

1. Treatment 1 – canopy removal prior to bunch initiation, at leaf count 14-15.
2. Treatment 2 – canopy removal at the time of bunch initiation, at leaf count 19-20.
3. Treatment 3 – canopy removal after the time of bunch initiation, at leaf count 24-25.
4. Treatment 4 – a control treatment with no removal of the leaf canopy.

Detailed measurements of plant growth and development (leaf count at bunch emergence, bunching and harvest date), bunch yield (total bunch weight and total fruit weight) and fruit length (hand number and weight of fruit in categories:- >260 mm, 220-260 mm, 200 – 220 mm and <200 mm) were recorded for each plant.

Growers who undertook pre-cyclone management strategies were generally only able to provide anecdotal data in relation to the impact on crop yields, fruit size and packing percentages (% packed fruit / % rejection).

4.1.2 Post-cyclone management strategies – staggered cropping program to return to cropping

In order to prevent a return to ‘synchronised’ cropping cycles a staggered cropping program was developed in consultation with the banana industry that proposed the staggered application of the “nurse-suckering” technique or replanting to provide a more consistent distribution of harvest once production returned.

A second agronomic trial was implemented at South Johnstone Research Station to monitor and assess the effectiveness of using nurse suckering as a means by which growers could stagger their cropping schedule designed in order to provide a more uniform return to fruit supply. Nurse-suckering is a technique used to time crop production where the following sucker is cut down and killed before it bunches which produces a flush of new suckers. One of these new suckers is then selected per plant to be the next crop cycle. This technique delays the cropping in a block by three to four months from where it otherwise would fall and increases the uniformity in a block. Thus the application of nurse-suckering in sequence across a farm can produce a series of relatively uniform, overlapping crop cycles. The trial was designed as a randomised complete block design with three replicates of each treatment and 60 to 62 plants per plot. It was used to provide a focus for extension activities for growers via field days and farm walks to assess the impacts on tree health, growth habit and bunching characteristics and yields.

The cropping schedule was based around four separate but overlapping production timings:

1. TC Yasi induced cropping cycle – no planned intervention, expected main harvest period Nov 2011 – Mar 2012 (“CR1”).
2. Early May 2011 “nurse-suckering” intervention – expected main harvest period Feb – June 2012 (“CR2”).
3. Early August 2011 “nurse-suckering” intervention – expected main harvest period Apr – Sept 2012 (“CR3”).
4. Late October 2011 “nurse-suckering” intervention – expected main harvest period Jul-Oct 2012. (“CR4”).

In addition to the nurse suckering trial conducted by DAFF above, previously collected data associated with the replanting of banana crops was also analysed. The replanting trials included in the analysis were:

1. Block replanted end April (“ToP3”).
2. Block replanted end July (“ToP4”).
3. Block replanted end October (“ToP5”).

Detailed measurements of plant growth and development (leaf count at bunch emergence, bunching and harvest date), bunch yield (total bunch weight and total fruit weight) and fruit length (hand number and weight of fruit in categories:- >260 mm, 220-260 mm, 200 – 220 mm and <200 mm) were recorded for each plant.

Therefore, there were a total of seven post-cyclone crop management scenarios evaluated for this study.

4.2 PRODUCTIVE AND FINANCIAL ASSESSMENTS

The primary goal of this portion of the project was to provide growers with an accurate analysis of the productive and financial impacts on a per hectare basis of a grower undertaking one of the two pre-cyclone crop management strategies or one of the six post-cyclone crop management strategies when compared with the control or CR1 trial, and also referred to as the “do nothing approach”.

To complete this analysis, growth and production data was supplied from the DAFF Queensland research trials discussed in Section 4.1 and from six commercial banana growers. Growers also provided data on crop management strategies employed, costs and returns data. Industry data on delivery volumes and pricing returns from selected major metropolitan markets was purchased by the consultants or supplied by the ABGC. A report outlining industry financial data compiled previously by other consultants was also supplied by the ABGC.

4.2.1 DAFF Supplied Data

Results from the trials discussed in Section 4.1 were presented in an Excel spreadsheet format by DAFF Queensland. The data was then analysed to calculate the following indicators for each treatment:

- % bells emerged per week

- % crop harvested per week
- Number of cartons harvested of each pack size per week per hectare for each trial.
- Number of cartons harvested of each pack size per week per hectare with provisions made for differences between commercial plantations and trial lots.

4.2.2 Grower Sourced Data

Six growers provided to the consultants the following:

- Through a series of grower interviews (multiple per grower) provide data on the crop management procedures that growers adopted immediately prior to and following Cyclone Yasi. Where different crop management procedures were followed data was obtained for each different 'treatment'. The data was compiled up to the first crop harvested for each treatment. Specific data collected included:
 - Pre- and post-cyclone crop management techniques utilised;
 - 'Clean up' techniques utilised;
 - Fertiliser, herbicide, pesticide and fungicide treatments (frequency, number of treatments, rates and costs) employed;
 - Packing rates and costs; and,
 - Commentary on the success or otherwise of the various crop management techniques used;
- Bell injection ("BI") and harvest data (BI numbers and timing, bunches harvested, packouts including sizes).
- Financial returns data by pack size for each delivery made by the grower.

Where relevant the data was compiled in a similar format to that used for the DAFF data so as to enable direct comparisons between treatments.

The financial and production data supplied was then used as input data for the production and economic models that were subsequently developed by the consultants.

4.2.3 Industry Sourced Data

There were three 'pieces' of 'industry' data sourced by the consultants:

1. Weekly North Queensland transport data for all major metropolitan centres in Australia supplied by the ABGC.
2. Wholesale pricing data x week x pack size for Brisbane, Sydney and Melbourne from May, 2011 to end October, 2012 purchased from Market Information Services. This data was then converted into farm gate returns and compared with the data supplied by growers.
3. A copy of the project report entitled "Banana Enterprise Performance Comparison #2" supplied by the ABGC.

The transport data was primarily used to highlight to industry the impact of TC's Larry and Winifred on delivery volumes (and by association production volumes) to major metropolitan centres. Further, correlations between prices received by growers and delivery volumes were examined in addition to the growth of production volumes over time.

Wholesale pricing and benchmarking data, in association with the individual grower interviews and information supplied, as well as other investigations conducted by the consultants, were used to develop sales returns and cost profiles for each of the crop management strategies analysed.

4.2.4 Model Development

From the information supplied from Sections 4.2.1 to 4.2.3 the consultants developed a series of interactive Excel models for each of the two pre-cyclone and seven post-cyclone production scenarios. Each model is capable of multiple scenario analyses. Each production scenario was analysed on a per hectare basis.

5 RESULTS

5.1 AGRONOMIC ASSESSMENTS

5.1.1 Pre-cyclone management strategies – canopy removal

The outcome of this practice was universal success in preventing roll out of banana plants. A significant additional advantage of this treatment was that these plants also started producing bunches much earlier than the suckers from those with a full leaf canopy that kinked or snapped in the wind. This early production provided a limited level of cash flow earlier than otherwise expected which was welcome in a time of great financial hardship.

The yield and quality of fruit produced by these bunches was variable, with most bunches having significantly reduced hand numbers and finger length.

The main results are presented in Table 1 and Table 2 below. The letters following the numbers indicate a statistically significant difference at a 95% confidence level. A 95% confidence level refers to a statistical confidence that if the same experiment was conducted 100 times the tester would get the same result at least 95 times.

Table 1: Effect of canopy removal on plant characteristics.

Treatment	Total leaf number	Leaf number at bunching	Time to bunch emergence (days)*	Time from bunch emergence to harvest (days)*	Time to bunch harvest (days)*
1	28.3	13.5	252.2 ^a	117.2 ^{ab}	369.5 ^a
2	27.2	10.7	238.8 ^a	112.9 ^{ab}	351.7 ^{ab}
3	29.7	5.1	207.0 ^d	115.7 ^a	322.8 ^c
4	28.5	14.7	232.8 ^b	104.2 ^b	337.0 ^{bc}
LSD 5%**	2.14	0.86	11.6	10.81	19.31

*data followed by different letters are significantly different.

** Least significant difference 5% - the minimum difference required between treatments for the result to be statistically significant at the 95% confidence level

Table 2: Effect of canopy removal on bunch characteristics.

Treatment	Bunch mass (kg)	Proportion of fruit 220-260mm in length mm (%)*	Proportion of fruit 200-220mm in length (%)*	Proportion of fruit <200mm in length (%)*	Finger length of banana on 3 rd hand (mm)*	No. of hands*
1	20.0 ^{cd}	61.5 ^{ab}	27.2 ^{bc}	6.6 ^c	233.0 ^{ab}	7.0 ^c
2	21.1 ^d	40.8 ^{bc}	39.1 ^{ab}	20.7 ^{bc}	225.8 ^b	8.6 ^b
3	25.3 ^{bc}	13.6 ^d	38.3 ^{ab}	48.1 ^a	210.3 ^c	9.2 ^b
4	38.9 ^a	64.8 ^a	22.9 ^c	10.2 ^c	240.4 ^a	10.3 ^a
LSD 5%**	4.63	19.06	16.62	13.35	10.11	1.22

*data followed by different letters are significantly different

Scheduling Banana Production After Tropical Cyclones

*** Least significant difference 5% - the minimum difference required between treatments for the result to be statistically significant at the 95% confidence level*

The key results from this analysis are:

1. Removing the leaf canopy at the three different stages of plant development reduced yield compared to the untreated plants.
2. Removing the leaf canopy prior to bunch initiation has the biggest impact on bunch yield, producing bunches with an average mass of only 20.0 kg (seven hands) compared to 38.9 kg (10.3 hands) from the untreated plants.
3. Removing the leaf canopy late in plant development (within 8 weeks of bunching) did not affect the number of hands produced as much as early removal when compared to the untreated plants – 9.2 hands (late removal) compared to 10.3 hands (untreated).
4. Removing the leaf canopy late in plant development had a major effect on fruit length at harvest (Hand 3 – 210.3 mm, last hand – 168.8 mm) compared to the untreated plants (Hand 3 – 240.4 mm, last hand – 190.1 mm).
5. The reduction in fruit length from late removal of the leaf canopy had a significant effect on overall bunch yield (25.3 kg) compared to the untreated plants (38.9 kg).
6. Removing the leaf canopy prior to bunch initiation, whilst reducing overall yield, did not significantly alter the fruit length or the proportion of fruit in the different length categories compared to the untreated control plants.

5.1.2 Post-cyclone management strategies – staggered cropping program to return to cropping

The results from the staggered cropping program are presented in Table 3 to Table 7. The tables present the harvest distribution and average monthly bunch yield and fruit characteristics measurements for each of the post-cyclone crop management strategies.

Scheduling Banana Production After Tropical Cyclones

Table 3: Percentage harvest distribution for staggered cropping trial at DAFF Queensland South Johnstone Research Station.

Crop timing	2011			2012												2013	
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	
TC Yasi cycle (CR1)	1	43	25	16	6	5	4										
May 2011 "Nurse-sucker" (CR2)			3	13	15	22	24	13	9	2							
Aug 2011 "Nurse-sucker" (CR3)						10	24	34	18	6	4	3	1				
Oct 2011 "Nurse-sucker" (CR4)									5	16	14	18	15	10*			
ToP3					1	37	61	1									
ToP4							1	33	49	13	4	1					
ToP5										12	25	24	21	11	4	1	

**harvest for 2 weeks only. 22% remain to be harvested*

Scheduling Banana Production After Tropical Cyclones

Table 4: TC Yasi crop cycle (CR1) characteristics for staggered cropping trial at DAFF Queensland South Johnstone Research Station.

Month	No. of Hands	Bunch weight (kg)	Fruit weight (kg)	% of Hands >260mm in length	% of Hands 260-220mm in length	% of Hands 200-220mm in length	% of Hands <200mm in length	Length of 3 rd hand (mm)	Length of Last hand (mm)	Days to Bell Emergence	Days to Bunch Harvest
Oct 11	7.5	-	-	-	-	-	-	250	-	141	250
Nov 11	7.3	32.7	27.6	81		19		248	204	185	292
Dec 11	8.1	31.6	28.6	69		31		238	194	228	314
Jan 12	9.9	-	-	-	-	-	-	234	-	261	343
Feb 12	10.3	-	-	-	-	-	-	241	-	283	379
Mar 12	10.5	37.9	33.9	73		27		237	194	323	403
Apr 12	9.0	37.3	33.8	81		19		249	207	352	435

Table 5: May “nurse-sucker” crop cycle (CR2) characteristics for staggered cropping trial at DAFF Queensland South Johnstone Research Station.

Month	No. of Hands	Bunch weight (kg)	Fruit weight (kg)	% of Hands >260mm in length	% of Hands 260-220mm in length	% of Hands 200-220mm in length	% of Hands <200mm in length	Length of 3 rd hand (mm)	Length of Last hand (mm)	Days to Bell Emergence	Days to Bunch Harvest
Dec 11	9.3	-	-	-	-	-	-	221	-	145	227
Jan 12	10.0	-	-	-	-	-	-	232	-	177	261
Feb 12	10.2	-	-	-	-	-	-	238	-	207	314
Mar 12	9.5	34.1	30.6	3	74	17	6	243	197	236	319
Apr 12	9.5	34.4	31.3	9	66	20	4	250	200	258	346
May 12	9.0	31.4	28.5	7	68	20	6	248	200	277	374
Jun 12	9.4	30.1	27.4	4	74	15	6	248	199	299	406
Jul 12	-	-	-	-	-	-	-	-	-	-	-

Table 6: August “nurse sucker” crop cycle (CR3) characteristics for staggered cropping trial at DAFF Queensland South Johnstone Research Station.

Month	No. of Hands	Bunch weight (kg)	Fruit weight (kg)	% of Hands >260mm in length	% of Hands 260-220mm in length	% of Hands 200-220mm in length	% of Hands <200mm in length	Length of 3 rd hand (mm)	Length of Last hand (mm)	Days to Bell Emergence	Days to Bunch Harvest
Mar 12	9.9	39.9	35.4	2	72	22	5	243	199	151	234
Apr 12	9.8	37.8	34.2	10	64	20	6	246	198	169	257
May 12	9.5	31.5	28.6	4	66	22	8	244	194	189	285
Jun 12	9.1	28.2	25.7	7	66	20	8	244	193	208	319
Jul 12	9.3	26.2	24.0	0	50	27	22	227	181	223	351

Scheduling Banana Production After Tropical Cyclones

Month	No. of Hands	Bunch weight (kg)	Fruit weight (kg)	% of Hands >260mm in length	% of Hands 260-220mm in length	% of Hands 200-220mm in length	% of Hands <200mm in length	Length of 3 rd hand (mm)	Length of Last hand (mm)	Days to Bell Emergence	Days to Bunch Harvest
Aug 12	8.7	24.9	22.5	0	56	27	17	229	182	235	376
Sept 12	8.5	23.7	21.6	0	58	22	20	231	187	263	410
Oct 12	8.0	20.8	18.7	0	45	31	25	233	191	299	431

Table 7: October “nurse sucker” crop cycle (CR4) characteristics for staggered cropping trial at DAFF Queensland South Johnstone Research Station.

Month	No. of Hands	Bunch weight (kg)	Fruit weight (kg)	% of Hands >260mm in length	% of Hands 260-220mm in length	% of Hands 200-220mm in length	% of Hands <200mm in length	Length of 3 rd hand (mm)	Length of Last hand (mm)	Days to Bell Emergence	Days to Bunch Harvest
Jun 12	10.8	38.0	34.2	4	68	17	11	249	189	125	236
Jul 12	10.7	35.0	31.5	1	58	23	19	235	181	142	264
Aug 12	9.5	29.7	27.0	2	63	21	13	241	189	166	297
Sep 12	9.3	29.3	26.8	1	57	25	17	235	187	184	323
Oct 12	9.3	28.8	26.5	2	50	30	18	234	176	234	357
Nov 12*	8.4	26.5	24.0	11	61	17	12	244	198	267	378

* harvest for 2 weeks only

Scheduling Banana Production After Tropical Cyclones

Figure 2 to Figure 9 demonstrate the spread of harvest for trials and farms under each of the eight crop management treatments.

Figure 2: Spread of harvest for farms replanted end April, 2011 (ToP3)

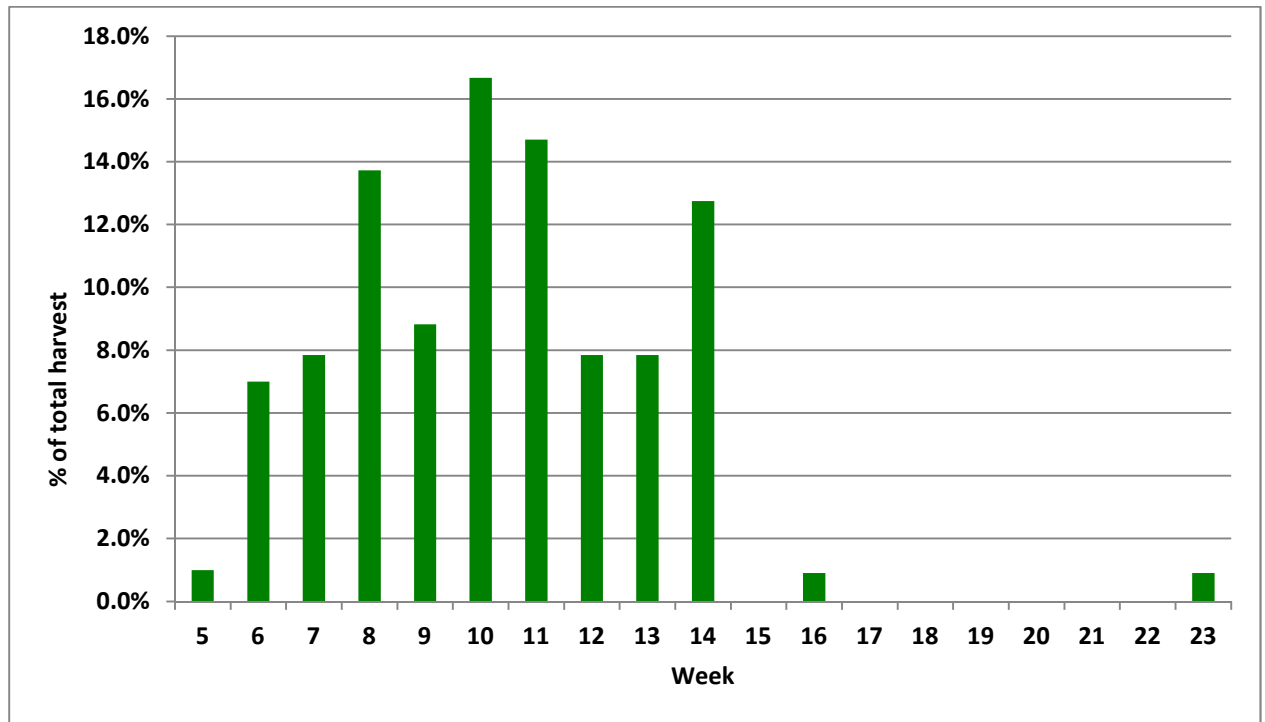


Figure 3: Spread of harvest for farms replanted end July, 2011 (ToP4)

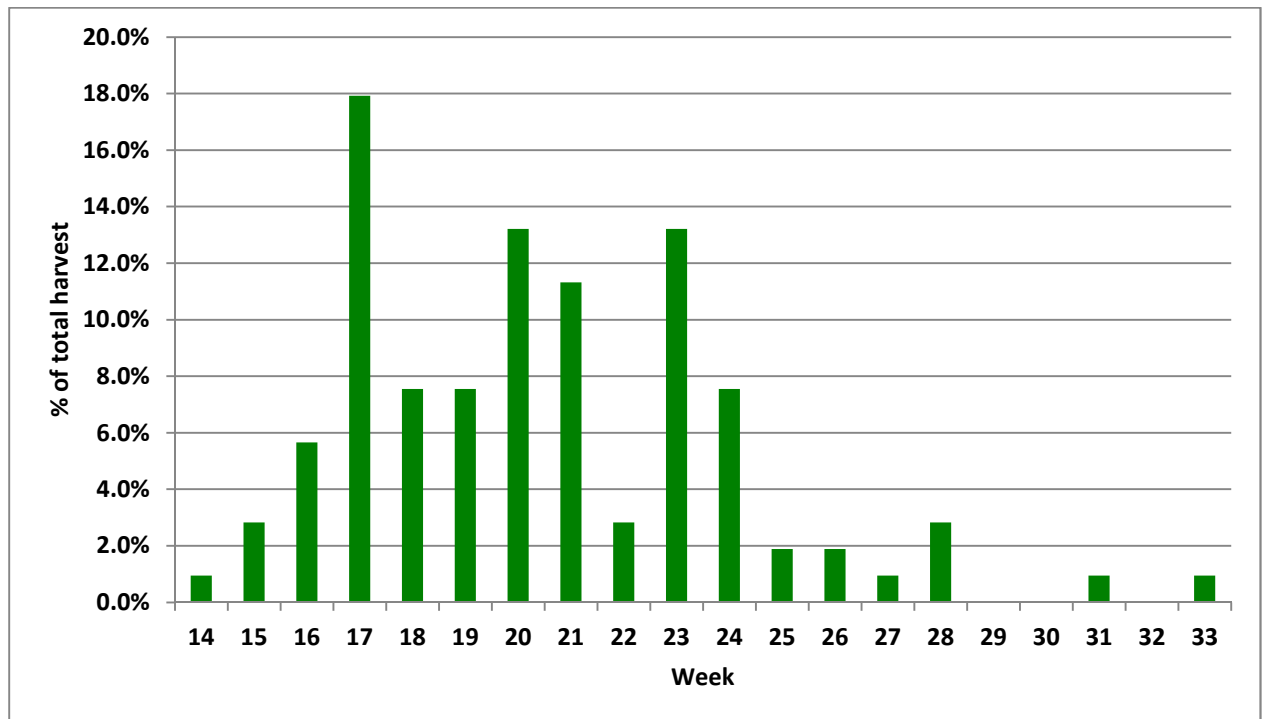


Figure 4: Spread of harvest for farms replanted mid October, 2011 (ToP5)

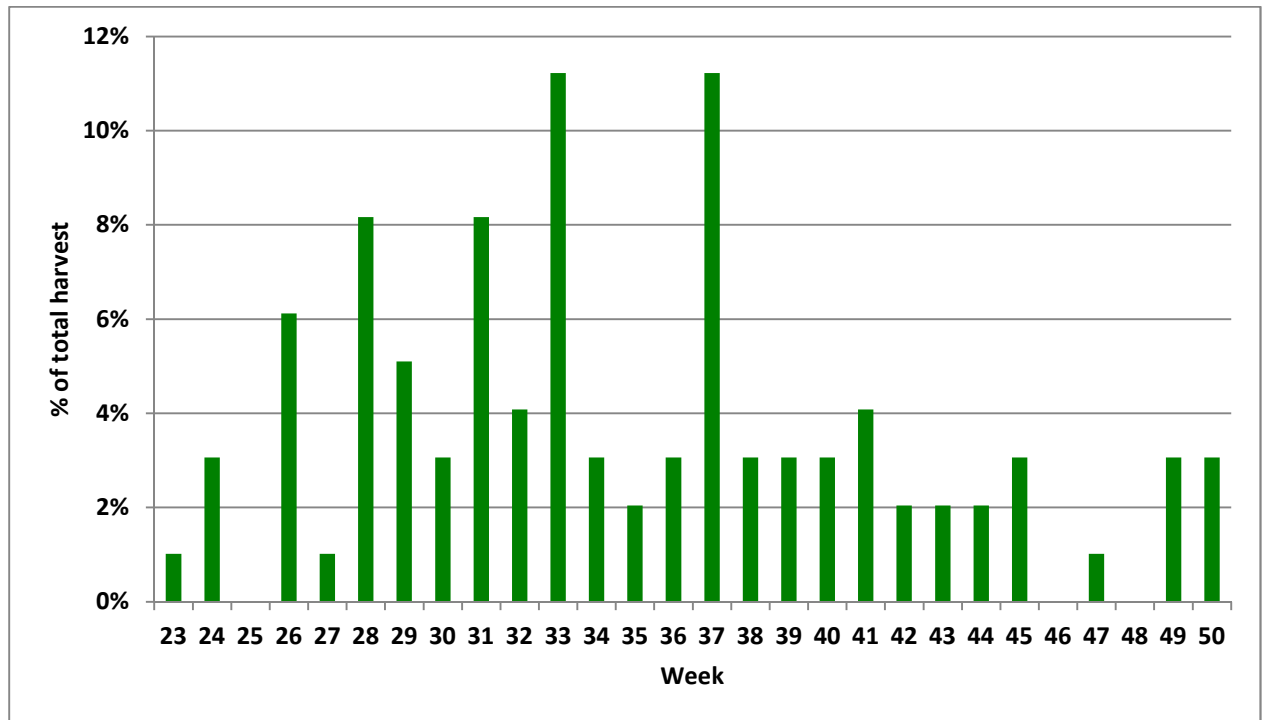


Figure 5: Spread of harvest for farms with no crop intervention after Cyclone Yasi (CR1)

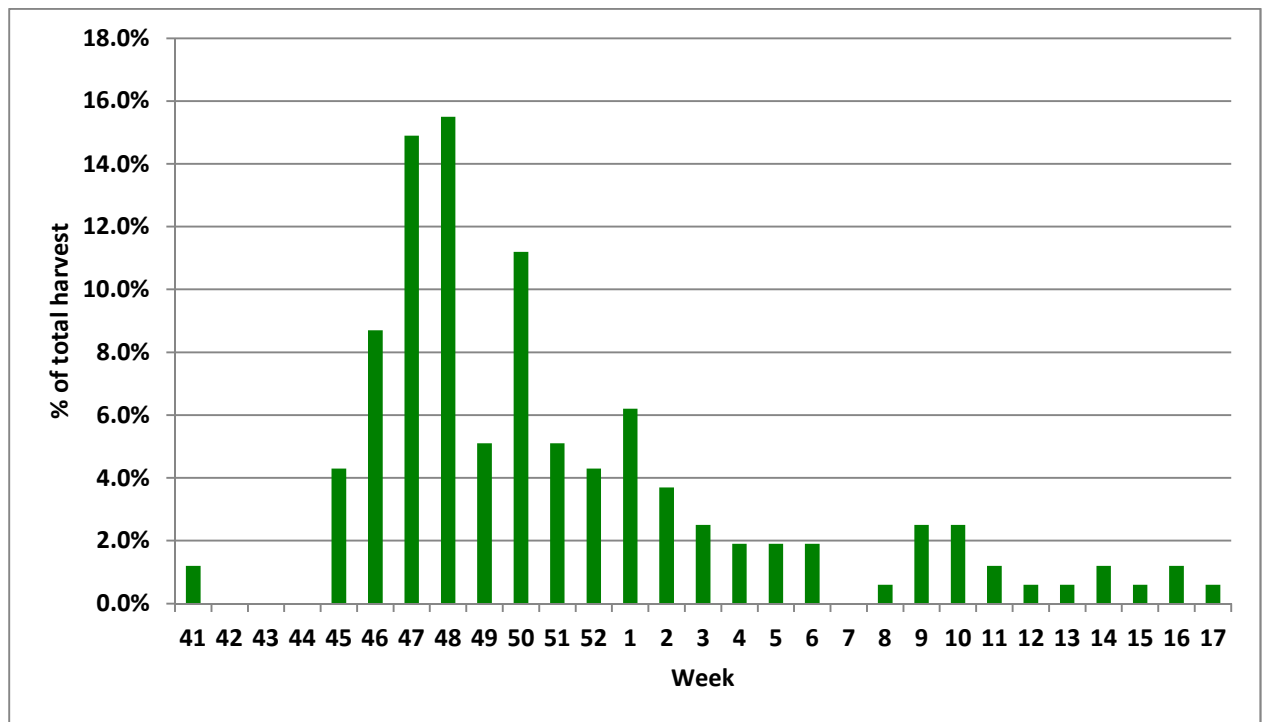


Figure 6: Spread of harvest for farms nurse suckered early May, 2011 (CR2)

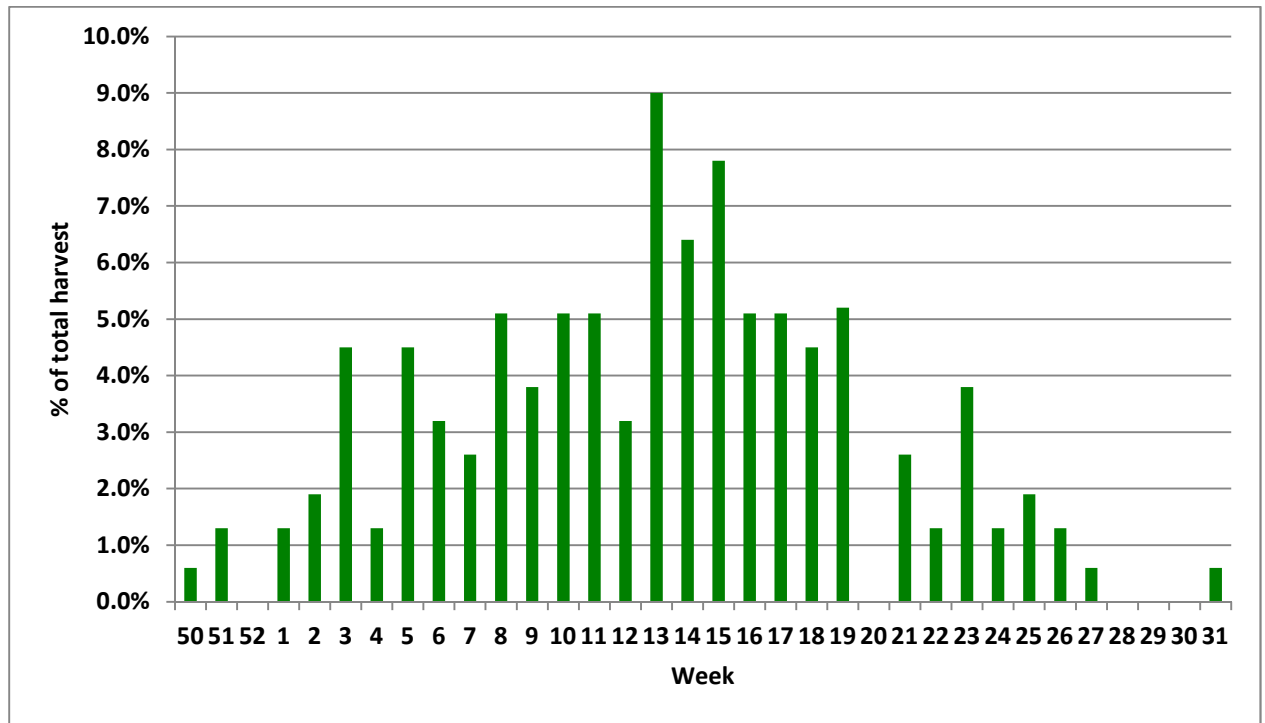


Figure 7: Spread of harvest for farms nurse suckered early August, 2011 (CR3)

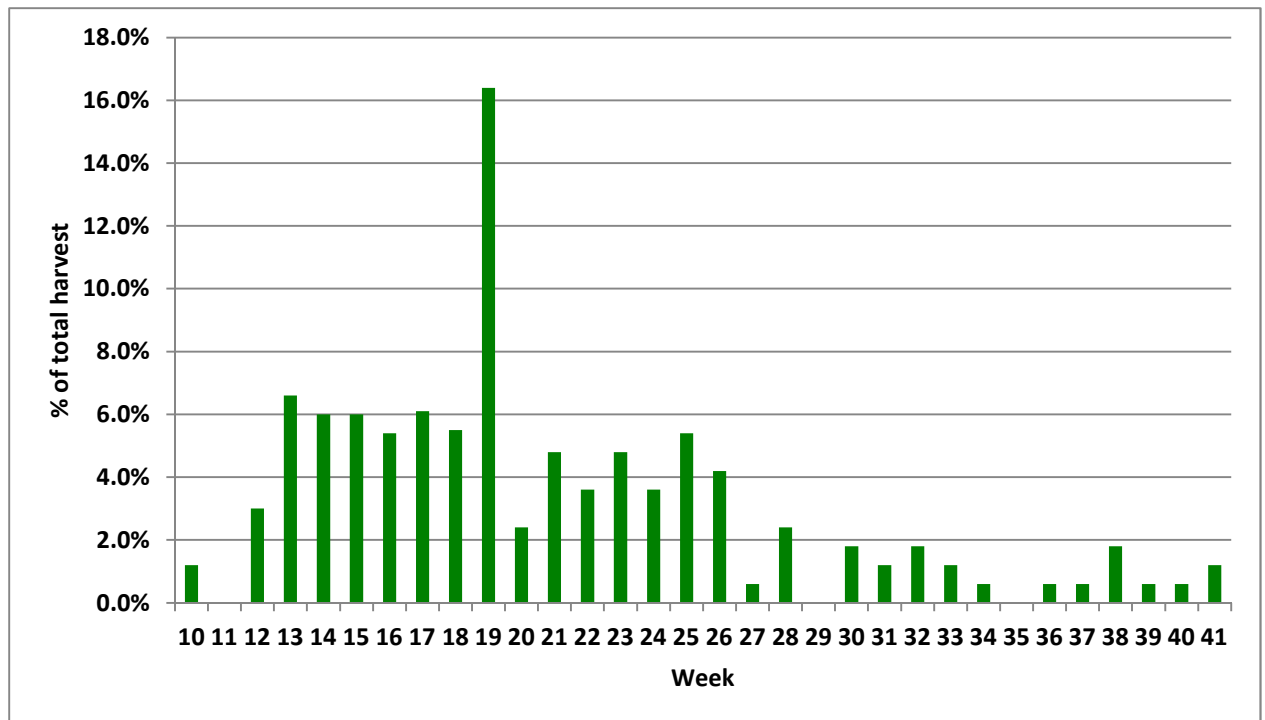


Figure 8: Spread of harvest for farms nurse suckered 2nd week , 2011 (CR4)

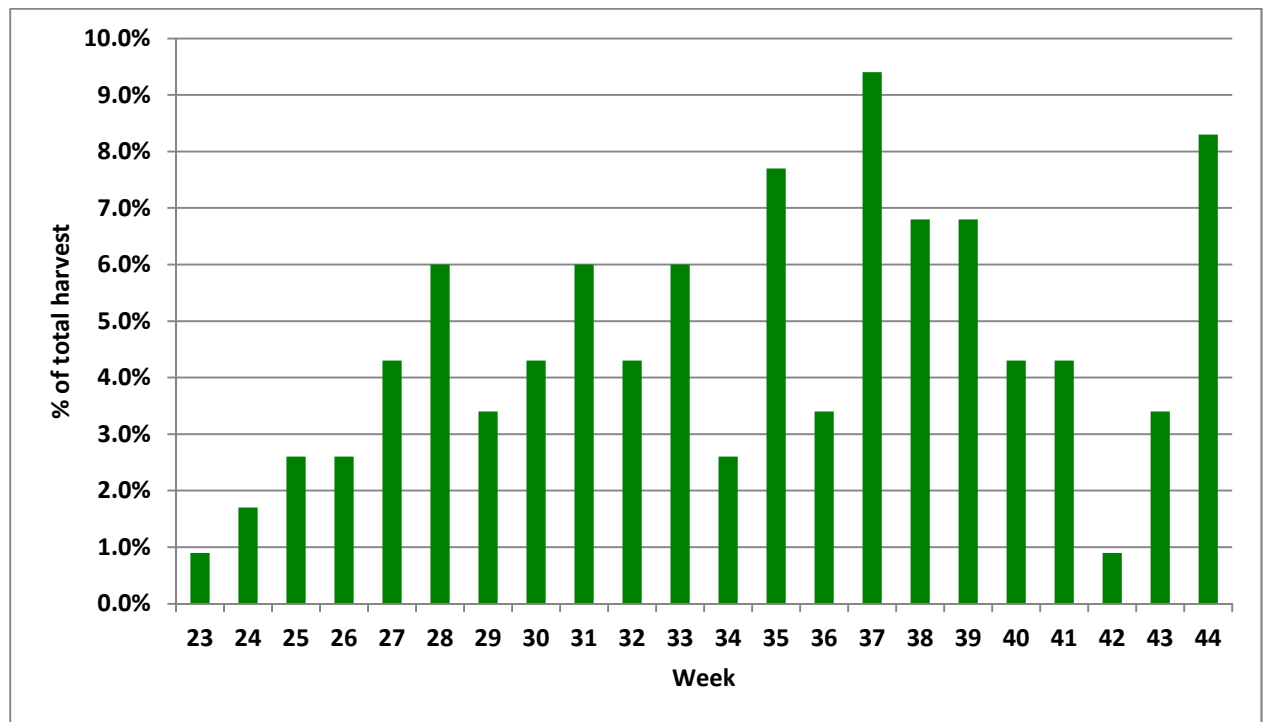
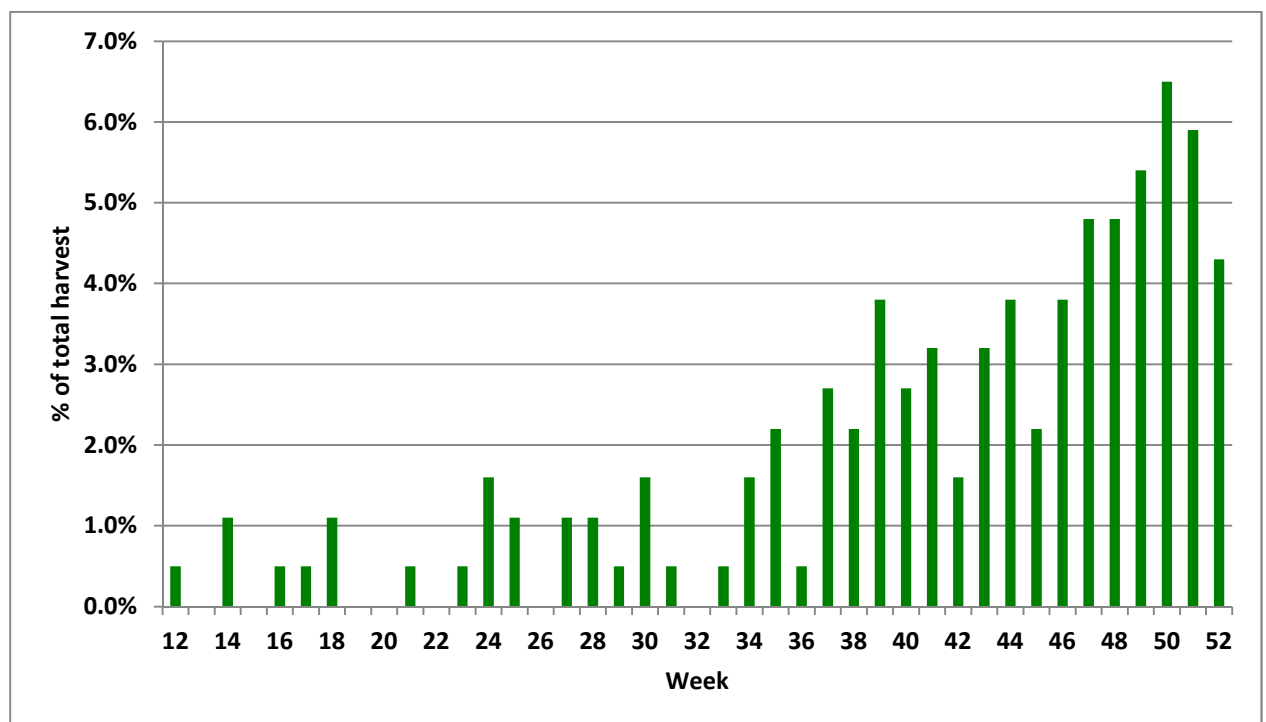


Figure 9: Spread of Harvest for farms with no crop intervention after TC Yasi (CR1) - 2nd cycle*



*Only 88% of the harvesting has been completed for this trial up to date of report completion

The key results are:

1. The staggered return to cropping significantly reduced the amount of fruit harvested during the Nov 2011-Feb 2012 period when the market experienced a significant oversupply. The CR1, or “do nothing approach”

treatment, produced 43% of the total crop from Oct 2011-Mar 2012 compared with 25% of the staggered cropping program during the same period.

2. The staggered cropping program increased the proportion of fruit harvested in the period from Mar-July 2012. During this period 47% of the staggered cropping program fruit was harvested compared to only 11% of the total CR 1 harvest.
3. Prolonged cool conditions during July and August contributed to a diminution of harvest for the period from week 30 to week 37 2012. Data for fruit length presented in Table 4 to Table 7 also shows the effect of seasonal conditions on the proportion of fruit harvested in the highest value 220-260 mm size category. From June 2012 to Nov 2012 the proportion of fruit in this category fell regardless of the treatment plot. Given that all management inputs were consistently applied to all the plots the best explanation is that the cooler and drier conditions reduced the fruit growth, resulting in a higher proportion of small fruit. This effect was also evident for some commercial banana growers during the same time period. At the time of writing the fruit length measurements for November indicate that the effect is reversing as temperatures and growth rates increase.
4. Harvest for the October 2011 “nurse-sucker” treatment is 78% complete in mid-November. Harvest forecast predicts 98% harvest completed by the end of 2012.
5. Although replanting as an alternative or complimentary strategy was not a component of this trial, previously collected data on harvest distribution can be used to demonstrate that a staggered cropping program can be achieved with staggered replanting (Table 3). There are a number of other considerations with replanting however, particularly the additional costs of crop eradication and land preparation and smaller bunch yields.

5.2 PRODUCTIVE AND ECONOMIC ASSESSMENTS

5.2.1 Impact of TC Larry & Yasi on banana production – 2006 to 2012

Since March, 2006 the North Queensland banana industry has experienced significant variability on an annual basis due to the impacts of TC Larry and Yasi. Since North Queensland represents over 90% of total national supply any variation in supply volumes, directly impacts on prices received by growers and paid by consumers.

Figure 10 shows that 2010 produced the greatest volumes of bananas ever grown in North Queensland at 24.02 million cartons. Anecdotal evidence provided by numerous growers indicated that from March, 2010 to January, 2011 prices received were generally below the costs of production. Similar anecdotal reports indicated that in general prices were at levels that enabled average growers to be profitable in 2008 and 2009. These observations were supported by the CDIPM (2011) benchmarking report which indicated an average gross margin for NQ Cavendish growers of 9.5% for 2009/10.

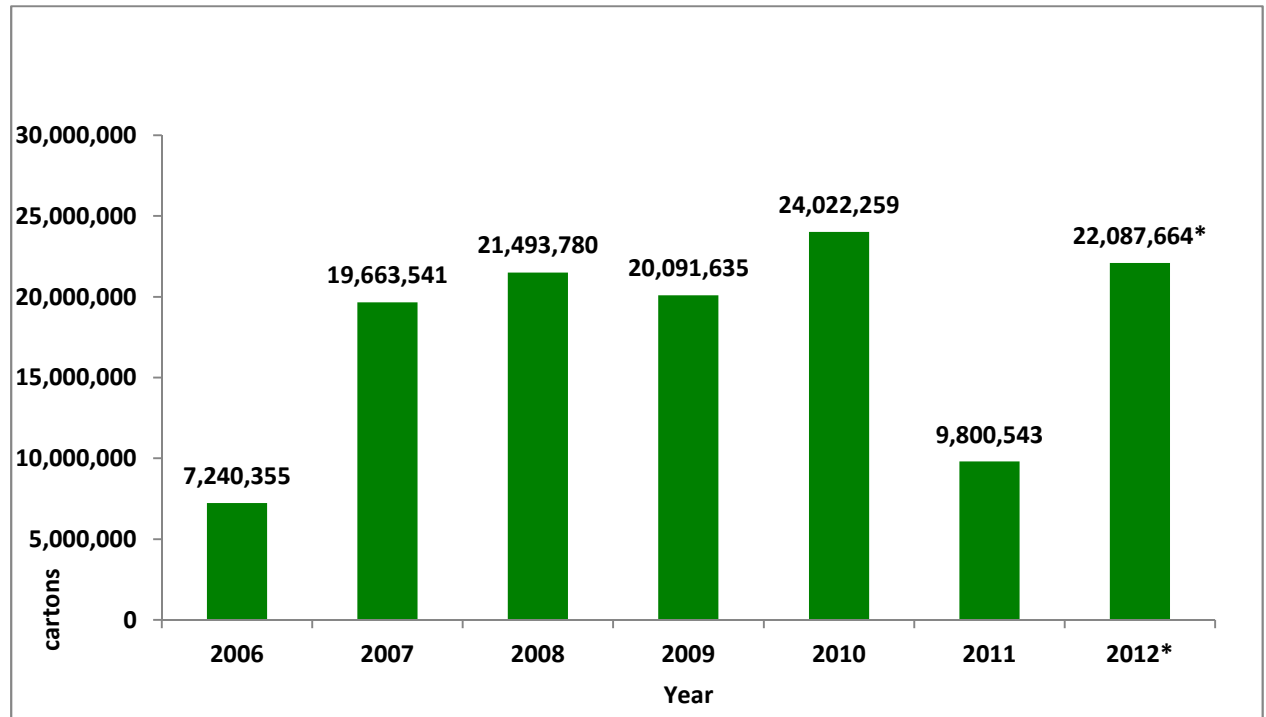
Therefore in the absence of demand growth the average weekly, grower return sustainable, demand for bananas in Australia (ignoring weather influences, competitor product supply volumes and prices etc) would appear to be around 400k and 420k cartons per week from North Queensland

Scheduling Banana Production After Tropical Cyclones

Assuming that the NQ industry produces 475k cartons per week for the last nine weeks of the year, 2012 will result in a total production of in excess of 22.09 million cartons, the second highest production level ever achieved.

Growers have indicated that production levels may have been even higher, but a long cool winter, some growers reducing the amount of inputs provided to their crops (particularly fertiliser and fungicide) and generally poorer health of the plantations contributed to a higher than normal percentages of large and medium sized fruit compared to extra large fruit.

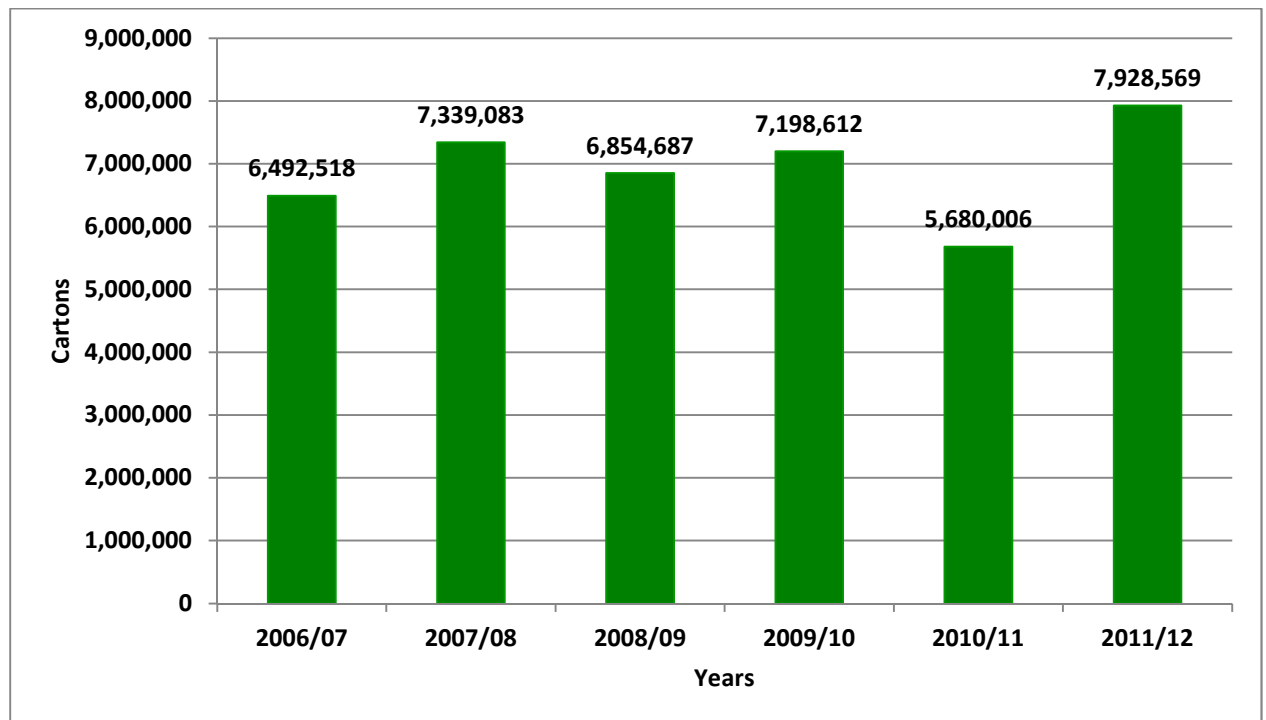
Figure 10: Total number of cartons delivered by North Queensland banana growers – 2006 to 2012



**Assumes 475k cartons per week delivered on average by North Queensland for the final 9 weeks of 2012*

Figure 11 shows that for the 21 week period during which banana volumes were at their greatest following Cyclone Yasi (Week 46 – 2011 to Week 14 – 2012) and prices at their lowest, the NQ banana industry delivered in excess of 7.9 million cartons which was nearly 600k more cartons than had ever been delivered in the same corresponding previously (which occurred in 2007/08).

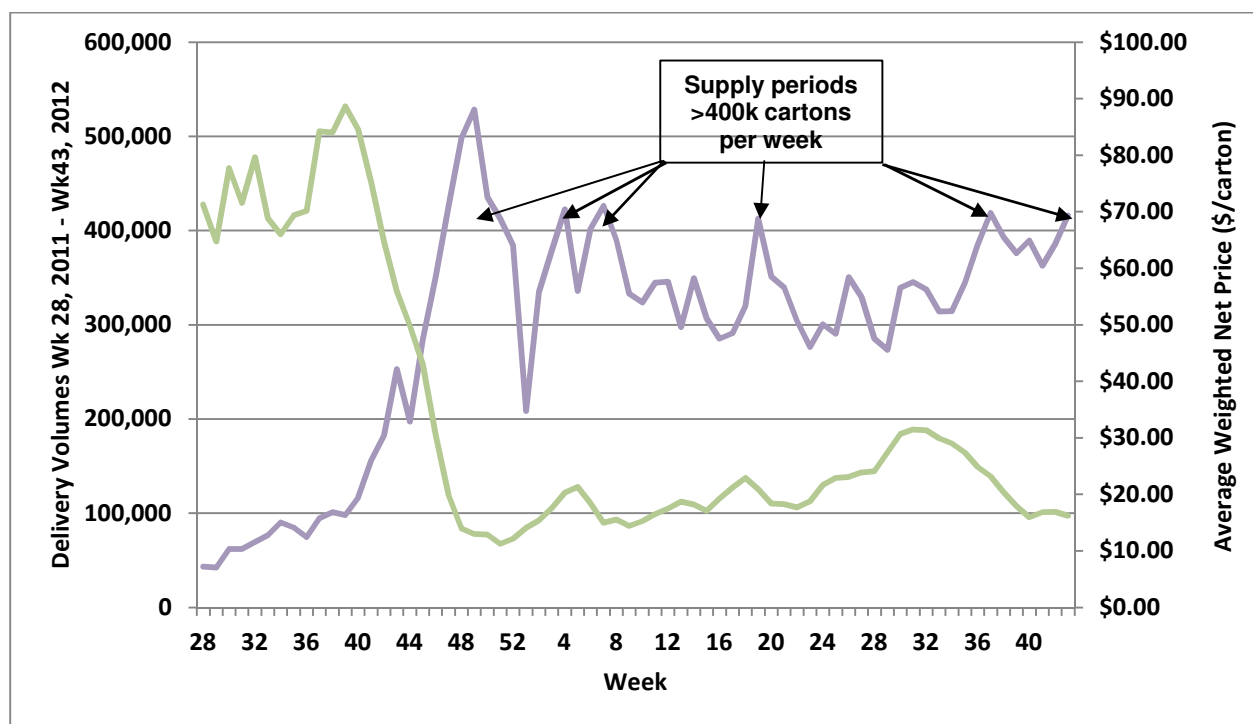
Figure 11: Total North Queensland Delivery Volumes Wk 46-Wk 14, 2006/07 to 2011/12.



5.2.2 Relationship between banana grower returns and delivery volumes

Figure 12 demonstrates the relationship between North Queensland delivery volumes and average net prices received by growers for the period Week 28, 2011 to Week 43, 2012. Week 28, 2011 was chosen as this represented the first period where new supply volumes from the cyclone impacted area became available, presumably from crops that had their canopy removed. Week 43, 2012 representing the last price period before data analysis commenced.

Figure 12: Average net sales returns & total North Queensland delivery volumes (Wk 28 – 2011 to Week 43, 2012)



Despite the best promotional efforts of the ABGC and DAFF, the significant periods late in 2011 and early 2012 where delivery volumes were in excess of 400k cartons per week, indicate that a significant percentage of the area grown in NQ was not subject to any crop management intervention (ie. CR1 – ‘do nothing approach’). When cartons delivered were in excess of 500k cartons per week the impact on prices, as demonstrated on this graph, was significant and lasted a number of weeks.

An analysis of average net prices received by growers (lagged two weeks to allow for delivery to market and ripening) and supply volumes confirmed a correlation coefficient of 92.2%. This figure indicates that 92.2% of the variation of the net prices received by growers is due to the supply volumes delivered by growers.

Some growers indicated during the course of this study that average prices were being manipulated by non-grower supply chain members and that with the level of supply being delivered average prices should have been higher. The correlation coefficient value does not support this view.

Figure 13 and Figure 14 demonstrate the average net prices received by five (anonymous) contributing growers for Extra Large (“XL”) and Large bananas from week 21 - 2011 to week 43 -2012.

Figure 13: Average net sales return for XL bananas of selected growers & industry sales reports (Wk 21 - 2011 to Wk 43 - 2012)

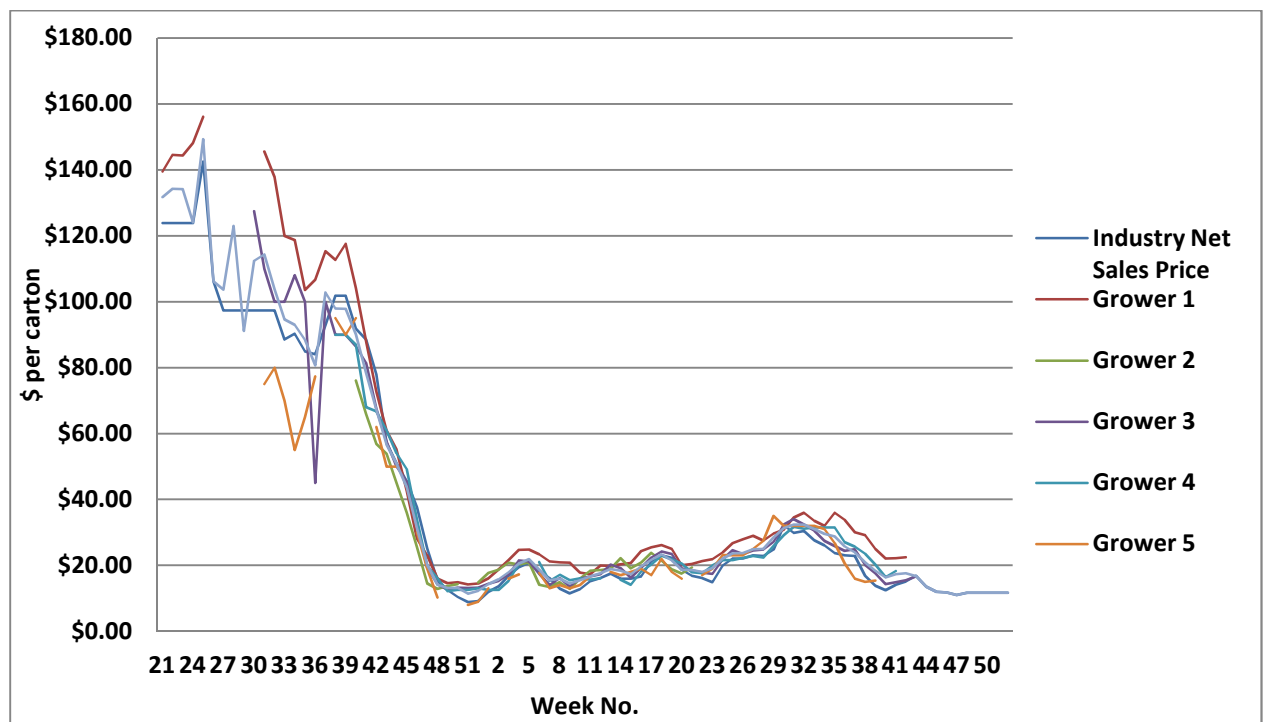
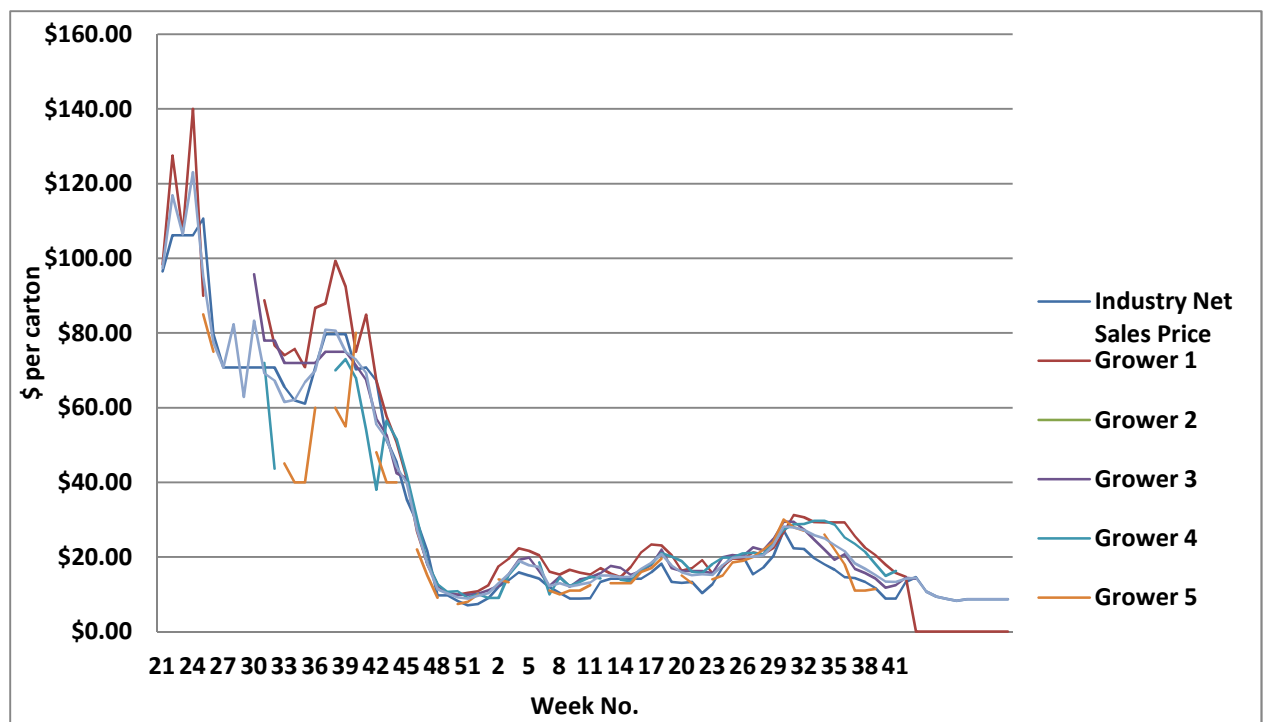


Figure 14: Average net sales return for Large bananas of selected growers & industry sales reports (Wk 21 - 2011 to Wk 43 - 2012)



The grower contributors involved a variety of business sizes and customer end types supplied. Some growers sold a majority of their bananas to major chains, were split suppliers (green loads / wholesalers) and one who was a dedicated wholesaler supplier. The figures do not include the very smallest of growers. The graphs demonstrate the relatively close prices particularly after Week 45 (2011)

approximately between these growers. There is no one grower who consistently has a higher average.

The prices for fruit supplied from Week 21 (2011) are variable between growers. This we believe is reflective of the variability of the quality of packs that were produced by growers during this period.

On the basis of the figures below the consultants are confident to use the net return figures supplied by these growers, in conjunction with the industry purchased data to calculate average weekly net sales returns for growers.

5.2.3 Average breakeven returns compared with weighted average net prices received – 2011 and 2012

The CDIPM (2011) benchmarking study identified that the average net sales return that NQ Cavendish banana growers required to breakeven was \$19.71 per carton. This figure also included a provision for wages to be paid to the working owners of the business as well.

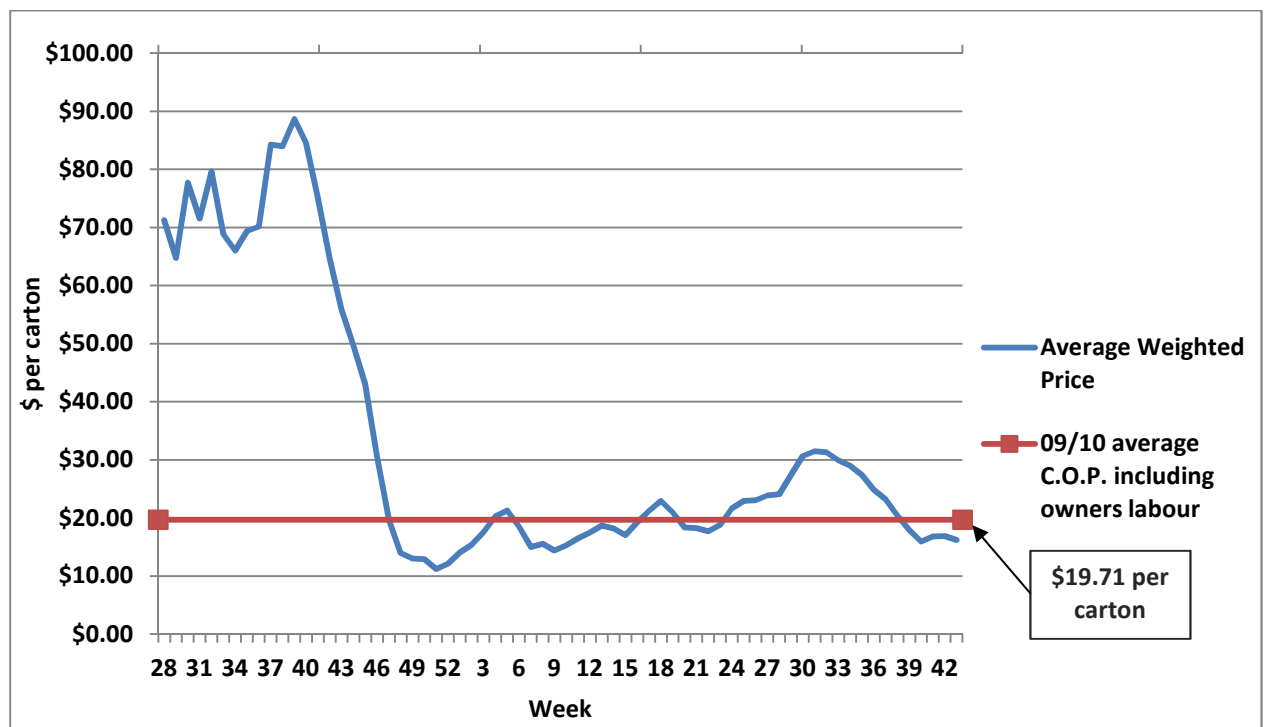
Figure 15 shows the relationship between the weighted average net price received from the combination of the five growers and the industry average data. The weighted price refers to an estimate of the percentage of fruit sold in each of the pack sizes produced by banana growers. The weighting was based on the actual percentage packouts from a number of the contributing growers only a weekly basis.

The red line shows the 2009/10 average net breakeven return. What Figure 15 shows is that for significant periods in late 2011 and early 2012 and again from late September 2012 the actual price received was below the breakeven return required by growers.

Conversely the average price was consistently well above the breakeven from mid-June to mid-September, 2012. Therefore “average” growers who delivered a significant percentage of their crop during these periods achieved good levels of profitability.

The consultants do stress however that the average breakeven price and in fact the average weighted returns are exactly that, average returns for growers. At any one time there will be a percentage of growers who are higher or lower costs of production and a percentage who have received higher or lower returns.

Figure 15: Average net sales return & average net breakeven price (Wk 28 - 2011 to Wk 43 - 2012)



5.2.4 Average net sales return per carton by crop management type

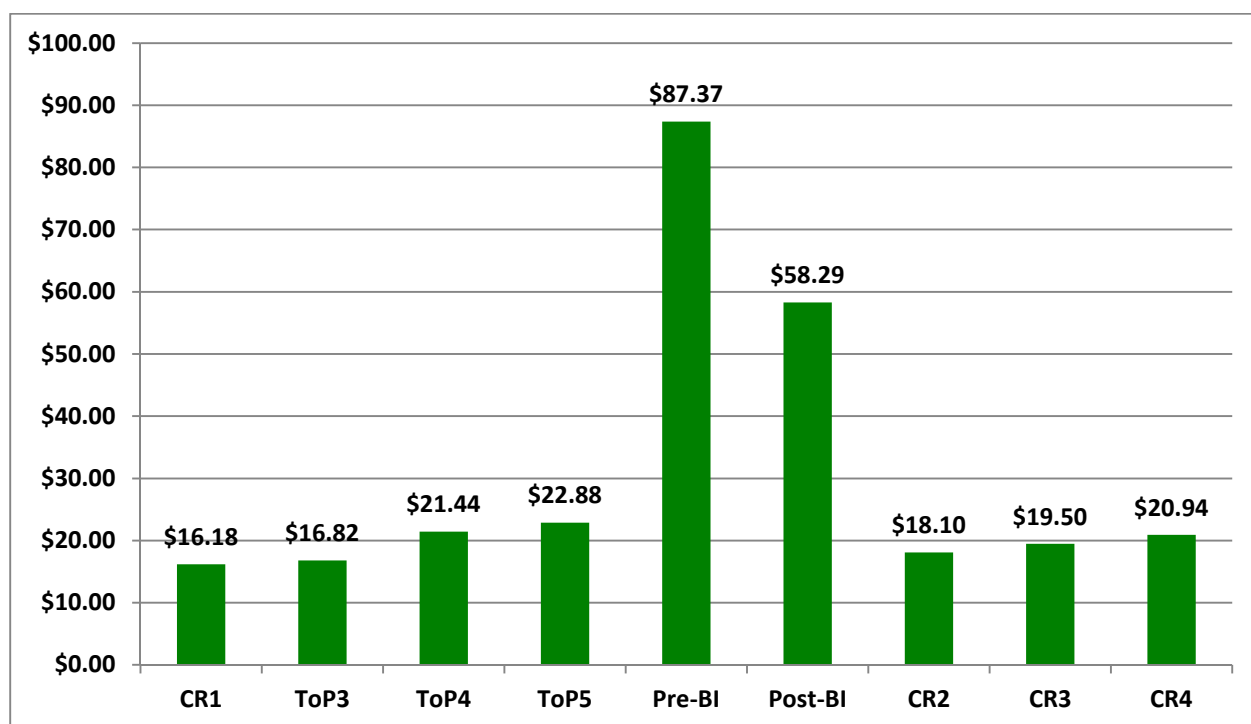
The consultants were able to using the average weekly price data provided by each of the five growers and the industry average to calculate an average weekly price across all six data sources.

Using this data in combination with the percentage of the crop that was consigned each week for each crop management type (see Figure 2 to Figure 9 demonstrate the spread of harvest for trials and farms under each of the eight crop management treatments.

Figure 2 to Figure 9) has enabled the consultants to calculate the average net sales return per crop management type.

These results are presented in Figure 16 below.

Figure 16: Average net sales return per carton by crop management type



The key observations and explanations of the results obtained from Figure 16 are:

- The average return for the CR1 treatment (“do nothing approach”) was \$16.18 per carton, which was the lowest of any of the treatments.
- New plantings made in March (“Top3”) resulted in a slightly higher average return than CR1, although the average return was still low at \$16.82. The low average return is due to the fact that the harvest period coincided with there being still significant volumes of bananas in the supply chain from the high supply period which did not end until Week 10/12.
- The slight improvement in returns (compared to CR1 and ToP3) from CR2 occurred as approximately 50% of the crop was harvested after Week 16 in 2012 which coincided with a general lifting in prices as the supply chain started to empty out on the back of decreasing supply volumes from around Week 10/12.
- Average prices increased for each treatment CR3 (\$19.50), CR4 (\$20.94), ToP4 (\$21.44) and ToP5 (\$22.88) increased due to the fact that higher supply percentages fell into the relatively higher priced periods of Week 22 to 38. The fact that prices were higher during these weeks confirms that the percentage of the total NQ crop falling into this period was ‘insufficient’ for consumer demand.
- Pre- and post- BI average prices were extremely high as production from these crops commenced in July, 2011 well before the CR1 fruit came into production.

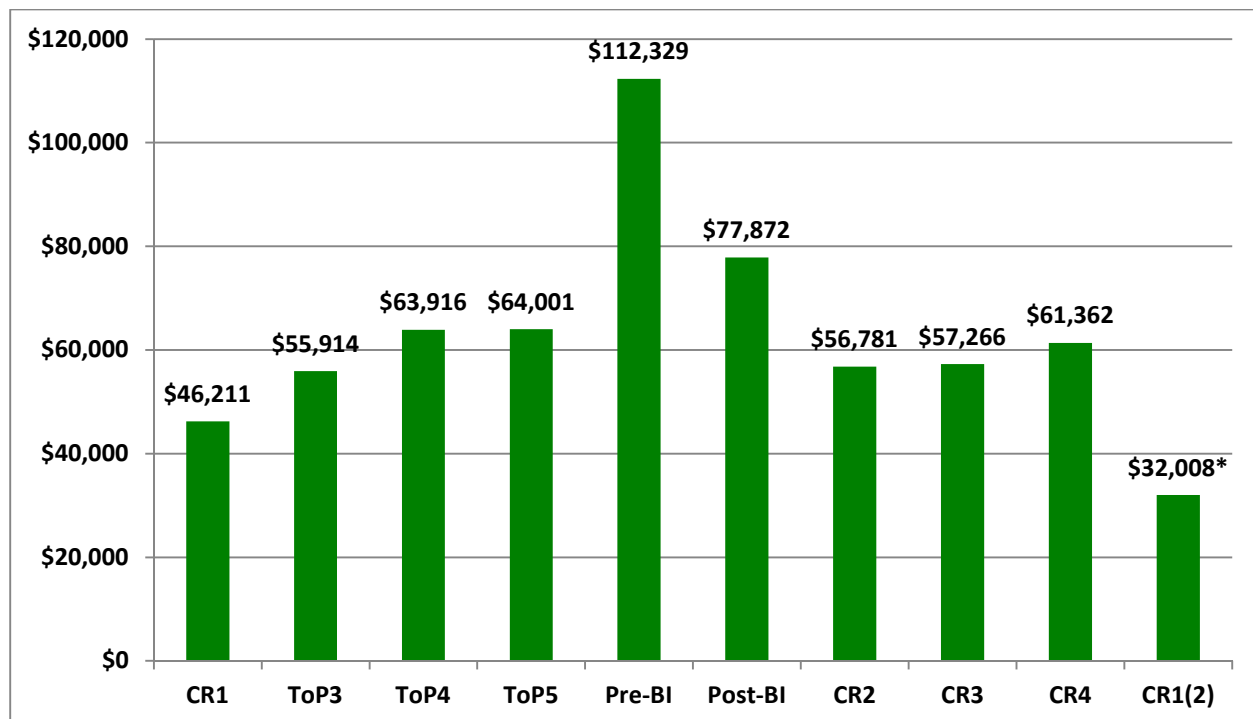
Scheduling Banana Production After Tropical Cyclones

- Pre-BI prices were higher than post-BI fruit as the earlier fruit whilst having lower yields produced a much higher percentage of fruit in the XL or large range compared to the post-BI fruit which was significantly smaller. The larger fruit always attracts higher average prices compared to smaller fruit.

5.2.5 Average net sales revenue per hectare by crop management type

Figure 17 presents the total net sales revenue per hectare for each of the different crop management treatments assessed by this project.

Figure 17: Total net sales revenue per hectare by crop management type, 2011 & 2012



*CR1(2) at completion of research trials had not completed harvesting all bunches and so the net sales revenue is inaccurate

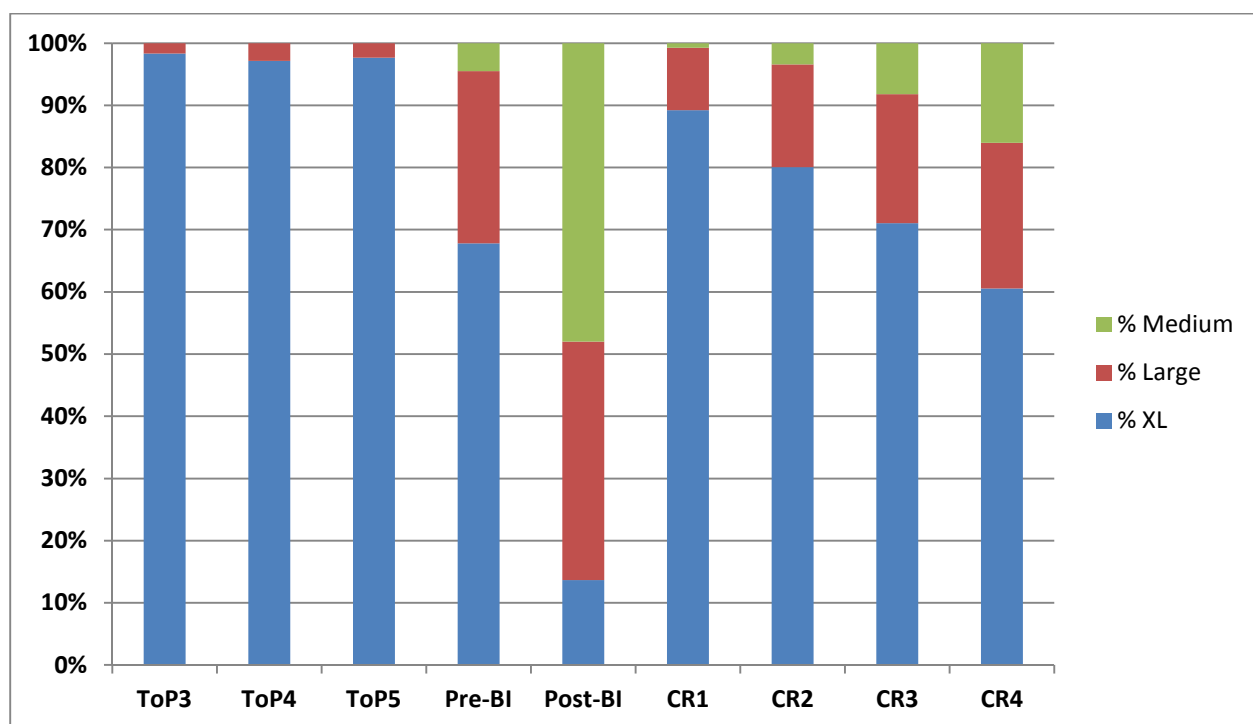
The key observations and explanations of the results obtained from Figure 17 are:

- The CR1 treatment (“do nothing approach”) provided the lowest return per hectare of \$46,211. This figure was \$9,703 per hectare (or 21.0%) lower than the next worst result of ToP3.
- The ToP3, CR2 and CR3 all produced similar results of \$55,914 to \$57,266 per hectare. Therefore based on sales revenue alone (thus ignoring production costs) there would appear to be limited difference in using each of these crop management scenarios and certainly they would produce a superior result compared to the “do nothing approach”.
- ToP4, ToP5 and CR4 all produced the best net sales returns per hectare of between \$61,362 and \$64,001 per hectare.

5.2.6 Fruit size distribution of different crop management types

Figure 18 presents the total net sales revenue per hectare for each of the different crop management treatments assessed by this project.

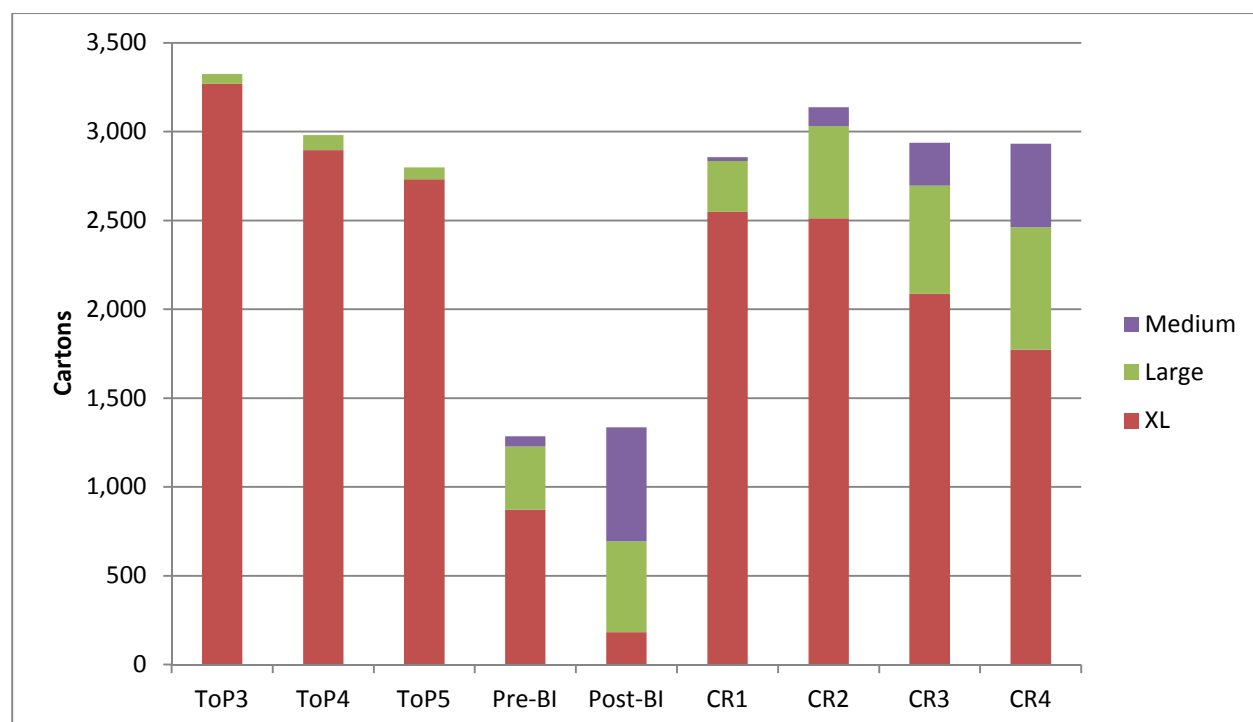
Figure 18: Fruit size distribution of different crop management types



5.2.7 Crop yields per hectare of different crop management types

Figure 19 presents the total net sales revenue per hectare for each of the different crop management treatments assessed by this project.

Figure 19: Number of cartons packed per hectare x pack type for different crop management types



5.2.8 Factors impacting variations in costs of production per hectare

Sections 5.2.5 outlined the net sales per hectare for different crop management types. Each different crop however has varying production costs per hectare associated with differences in the following:

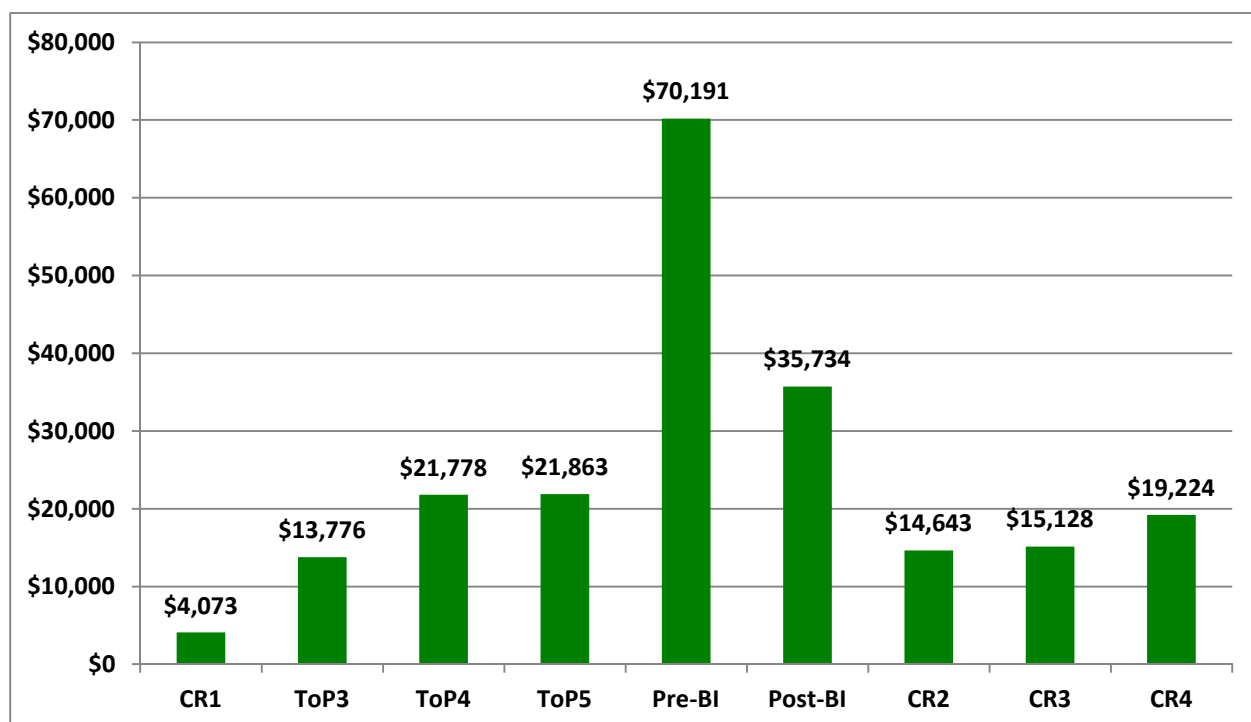
- Packing rates (depending on fruit quality)
- Harvesting rates (depending on fruit densities)
- Carton costs (due to differences in the number of cartons harvested per hectare)
- Freight (due to difference in the number of cartons harvested per hectare)
- Fertiliser (due to crop management practice particularly in relation to nurse suckering and timing)
- Bell injection (due to variation in plant densities and crop distribution)
- Bags & bagging (due to variation in plant densities and crop distribution)
- Desuckering (dependant on crop management program)

Scheduling Banana Production After Tropical Cyclones

- Deleafing (dependant on crop management program)
- Nurse suckering (dependant on if the practice is used or not)
- Fungicide / pesticide costs (dependant on crop management program)
- Stringing (due to variation in plant densities and crop distribution)
- Planting new crops (dependant on if the practice is used or not)
- Contracting or in-house labour utilised (impacts on productivity rates and costs)

Based on the input from the six growers and information made available in CDIPM (2010) variances in costs for each treatment type were calculated. This information was then used to calculate the net profit per hectare (before tax) as presented in Figure 20 below.

Figure 20: Average net profit per hectare before tax by crop management type



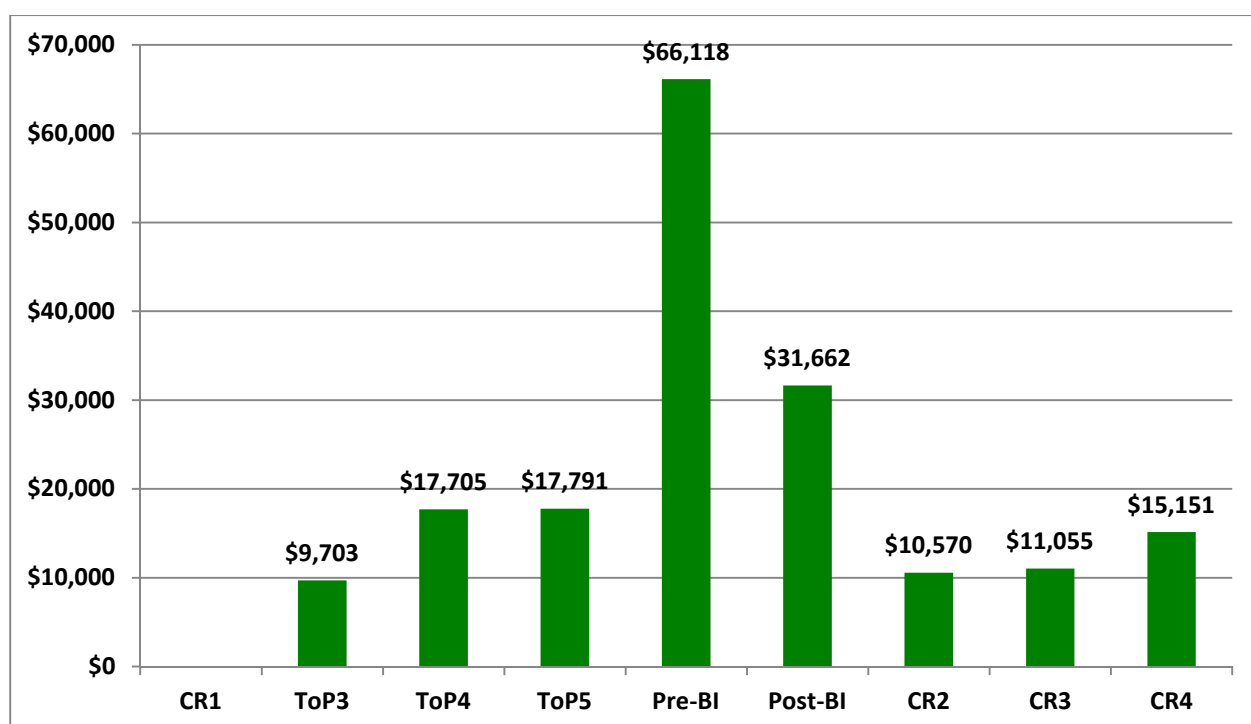
Scheduling Banana Production After Tropical Cyclones

The key observations and explanations of the results obtained from Figure 20 are:

- The CR1 treatment (“do nothing approach”) generated a modest net profit (before tax) per hectare of \$4,073. Growers would generally regard this as a disappointing result following a cyclone year. CR1 produced the worst net profit result of all of the treatments.
- The ToP3, CR2 and CR3 all produced similar results of \$13,776 to \$15,128 per hectare.
- ToP4, ToP5 and CR4 all produced the best net profit (before tax) returns per hectare of between \$19,224 and \$21,863 per hectare.
- Canopy removal trials generated very significant net profits compared with the other treatments of \$35,734 (post-BI) and \$70,191 (pre-BI).

Figure 21 shows every different crop management type produced a superior net profit compared to CR1 (“do nothing approach”).

Figure 21: \$ gain in net profit before tax per hectare by crop management type compared to CR1



6 DISCUSSION

6.1 AGRONOMIC ASSESSMENTS

6.1.1 Pre-cyclone management strategies – canopy removal

The application of this treatment preceding TC Yasi by banana producers was focused mainly on maintaining the productivity of individual plantings by preventing excessive “roll out” of plants. The outcome of this practice was universally successful in maintaining banana plants as productive units thus validating the concept of reducing wind resistance by removing the leaf canopy.

Observations and reports from commercial farms indicated that the canopy removal method where the plants are defoliated and then the pseudostem is cut just below the youngest fully emerged leaf (Figure 31) provided additional pseudostem strength during the subsequent bunch filling period. The other canopy removal method where the pseudostem was cut through below the oldest leaf often resulted in a very weak regrowth pseudostem, particularly if the plant produced 5 leaves or less before bunching. These spindly regrowth pseudostems often broke or kinked under the weight of the developing bunch causing the loss of the fruit. For this reason the defoliation method of canopy removal was used on the trial at South Johnstone.

A significant additional benefit of this treatment was earlier production of bunches, beginning six months after the cyclone impact. This early production provided a level of cash flow earlier than otherwise expected which was welcome in a time of great financial hardship. The productivity of these bunches was poor compared to normal production, especially the initial harvests, with commercial box/bunch ratios around 0.3 compared to commercial standards of between 1.4 and 1.7.

Due to the limited time period which growers had to remove canopies, typically between 24 and 48 hours, the total area that each grower was able to remove was limited to a few hectares typically. Therefore the quantum of the total cash flow from canopy removal, although welcomed, was typically relatively insignificant in terms of the overall cashflow of the business on an annual basis.

The canopy removal trial at South Johnstone Research Station showed that the stage of plant development has a significant effect on yield and finger length characteristics. All the canopy removal treatments significantly reduced yield but the treatments that removed the canopy after bunch initiation had begun had the most significant effect on fruit length.

It is almost certain that widespread adoption of the canopy removal technique will be implemented in the event of future cyclone threats. The specific application of this technique will depend greatly on the nature of the cyclone. A very large and powerful storm impact directly on the coastal production region, like TC Larry or TC Yasi, has a very high probability of destroying the vast majority of banana production. In this scenario canopy removal of any plants regardless of their stage of development will provide significant financial benefit because the market will accept very short fruit that normally falls outside the product specification for normal supply conditions.

However, in a scenario where a significant proportion of normal fruit supply remains, for example with a smaller cyclone or landfall distant to the production region, then canopy removal should be targeted at smaller, pre-bunch initiation plants first as their subsequent fruit characteristics are commensurate with untreated plants. The determination of pre-bunch initiation stage plants in our trial was done by leaf count;

however banana producers could work off plant height with plants in the 2.0-2.2 m height range the best approximation.

6.1.2 Post-cyclone management strategies – staggered cropping program to return to cropping

The objective of this trial was to identify crop management techniques that permitted a return to consistent, continuous fruit supply after a cyclone impact as quickly as possible. This trial has been successful with the identification of multi-stage crop management strategy achieving this objective. A 'do nothing approach' results in a significant peak in production well in excess of sustainable demand.

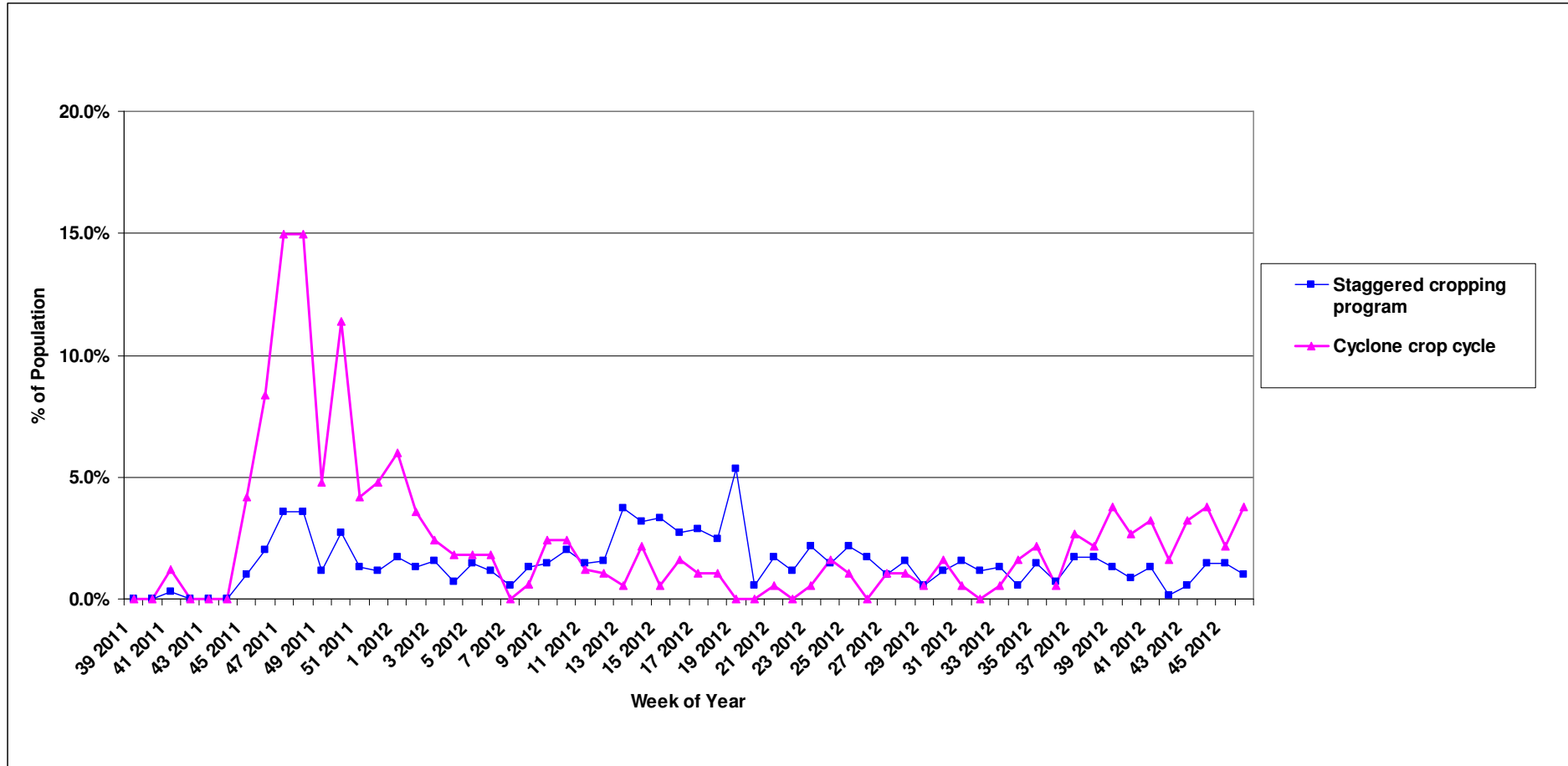
Figure 22 shows the comparison of the harvest dynamics for the staggered cropping program (with 25% of each CR1, CR2, CR3 and CR4) with the "do nothing approach or CR1" unmanaged cyclone crop cycle.

The addition or replacement of a ToP treatment (new planting) will result in a higher peak as the distribution of production (see Figure 2 to Figure 4) for new plantings is tighter than the CR treatments which resulted in production occurring over a more extended time period (see Figure 5 to Figure 9).

The results from the South Johnstone trial site represent a scenario where the production area is allocated equally to each of the 4 crop schedules. The results from the trial show that by applying the staggered cropping program the proportion of overall production of the cyclone cycle from Nov 2011-Feb 2012 was reduced from 81% to 21%. Conversely the proportion of harvest from the unmanaged crop cycle between week 4 and week 36 - 2012 was only 33% compared to 57% for the staggered cropping program.

This staggered cropping pattern can now propagate at its own rate, further smoothing the fruit supply and contributing to a more rapid return to a normal supply situation than in the unmanaged scenario.

Figure 22: Comparison of the harvest dynamics for the staggered cropping program with the unmanaged cyclone crop cycle.



6.2 PRODUCTIVE AND ECONOMIC ASSESSMENTS

6.2.1 Introduction

In considering the productive and economic analysis portion of this project report the reader needs to be aware that this returns analysis were based on the events as they pertained TC Yasi.

TC Yasi, like its counterpart TC Larry, caused very wide spread destruction of the main banana production region of the Wet Tropics. Therefore large areas of bananas were impacted by these two storms. Therefore the impact on price returns was significant, with Cavendish bananas being sold for up to \$180-\$190 per carton.

A smaller, less complex cyclone will result in less of an impact on price returns as a smaller region of bananas will be affected.

Therefore a grower when considering this report should be cognisant of the likely impacts a cyclonic event may have on industry wide production, for up to 2 years.

Further, this analysis, particularly as it relates to farming practices / management styles and costs of production, is based on a limited sample of growers. Every grower has a different approach to the way that they manage their plantations and therefore cost structures vary. Growers are strongly urged to consider this when they are considering the data presented in this report.

And lastly, the reader should be aware that the sales returns and costs data, is 'averaged' data. Individual growers may have a higher or lower average costs of production, average sales returns may be higher or lower and finally, productive performance will be better or worse than average. Again growers are urged to assess their own individual circumstances when assessing the results of this report.

6.2.2 Pre-cyclone management strategies – canopy removal

From an economic viewpoint, a grower confident that a cyclone will impact at least a significant portion of the NQ banana production, will in all circumstances be financially better off by removing the canopy of some of their blocks. The potential financial benefits on a per hectare basis are significant (up to \$66k per hectare based on TC Yasi) and will also allow the crop to return 'out of sync' with blocks for which the 'do nothing approach' is undertaken.

This study did not assess the financial benefits associated with having less rollout / plantation damage. The costs in circumstances where there are high percentages of rollout will be significant as the ongoing operational costs of the affected blocks will be amortised over less trees.

Further, by commencing harvesting earlier than farms that do not undertake any crop management strategies, growers are able to provide work for valued employees making it easier to retain key staff.

Also by having a portion of the blocks canopy 'managed' grower (and industry) production is smoothed out somewhat making for more ordered marketing.

And lastly, having bananas available five to seven months after a cyclonic event allows consumers to re-acquaint themselves with the fruit rather than having to be 'turned back on' to buying the product which will have in our opinion demand benefits when higher volumes of fruit subsequently become available.

Section 6.1.1 outlines the best stage of growth that a block should be at in respect of achieving the best possible economic outcome for the grower (ie. Pre-BI). In particular where cyclones are only a going to impact a percentage of the North Queensland area growers should be cautious in 'treating' blocks that are Post-BI as Small and Medium sized fruit is always heavily discounted in the market place, thus reducing the potential financial benefit.

Growers however should be aware that there is a risk associated with significant canopy removal. If the cyclone does not impact a grower's crop or the cyclone does not have a significant or any impact on the growing region, the grower will be without any income for around 5-7 months and the crop volumes per hectare will be low again impacting costs.

6.2.3 Post-cyclone management strategies – staggered cropping program to return to cropping

Following TC Yasi, the average grower who undertook any one of the assessed crop management strategies would have benefited financially by a minimum of \$9,703 per hectare. This represents an increase of approximately 20-25% on average farm revenues.

Some growers argue against the benefits of nurse suckering. A typical response is *"Why would you cut a crop down that you have grown for [5-7 months] and then have the expense of growing the crop again for [9-10 months]"*

This study has shown that for say an average 50 hectare grower after TC Yasi who adopted the 'do nothing approach / CR1' that the net profit before tax generated would equal \$204k before tax. However a grower who adopted, say a 25% CR1, 25% CR2, 25% CR3, 25% Top5 strategy would have generated a net profit of \$696k after additional growing costs have been taken into consideration.

An additional factor why some growers are reluctant to undertake nurse suckering is their own attitude to risk. That is they 'know' what will happen to trees that are not nurse suckered and are 'uncomfortable' to undertake anything new. Studies such as this the consultants trust may go some way to alleviating these perceptions.

The consultants wish however to point out to growers the following in respect of this analysis:

1. The figures presented are 'average' ones. Individual growers will benefit (or not) at different rates depending on their costs of production, block productivity and marketing skills. This study now has a modelling tool which can be used by all growers (possibly with assistance) to 'quickly' assess either just before or just after a cyclonic event the financial impacts of potential scenarios.
2. TC Yasi and TC Larry were severe cyclones which impacted a significant percentage of total NQ (and Australian banana production). The financial benefits associated with undertaking staggered crop management strategies will be lessened where cyclones have less of an impact on total industry production. Production in non-CR1 time slots will be better maintained by non-cyclone impacted growers thus reducing the potential financial benefit.
3. As growers shift more and more production away from the "do nothing approach / CR1", the financial benefits from undertaking these strategies are

expected to be less as production becomes more even. Determining a more accurate of the 'ideal' production mix is not feasible given the high number of variables that exist (degree of cyclone impact, timing of cyclone, variations in individual business performance etc.). Certainly a crop management mix such as presented in Figure 22 would result in an improved consistency of delivery of bananas to consumers.

4. The second cycle of "do nothing / CR1" bananas commenced in September and hit high levels in late October / November. This has forced a downward movement in prices received. Therefore the authors are able to conclude that the quantum of price benefits from undertaking various crop management strategies after TC Yasi is not just limited to one cropping event, but is expected to occur for 2 to 3 cropping events until production from each cycles starts to become spread and overlap.
5. Non-assessed benefits of staggered crop scheduling include:
 - a. Growers are not faced with the situation where labour demand is low (because there is limited fruit to harvest) to having a very high labour demand as the CR1 peak with TC Yasi hit. Sourcing labour was an issue in late 2011 / early 2012. Further, having to train so much labour in a small timeframe would place significant pressure on farm owners / managers, which would lead in turn to efficiency losses.
 - b. Other inputs suppliers, in particular transport operators are placed under less pressure to supply trucks. Conversely, anecdotally we understand some growers did not cut fruit purely because they were not able to shift it. If that fruit had been harvested the price impact late 2011 / early 2012 glut would have been even worse.
 - c. Anecdotal evidence from retailers indicated that consumers may not have become 'switched back on' to consuming bananas until towards the end of the first quarter of 2012. Retailers indicated that there was ample supplies of competing fruits at this time of year e.g. stonefruit, grapes etc. In addition the belief was that the majority of consumers had gotten 'used to' not having bananas as a staple and so took time to regard them this way again. It is therefore unrealistic of the banana industry to expect them go from 'zero to maximum' production in such a short period as did occur in late 2011 / early 2012. A more gradual improvement in production volumes would achieve better supply matching and potentially less of such as such a disastrous fall in prices.

6.2.4 Project Summary

In summary, this study has shown:

1. That growers implementing staggered crop scheduling strategies following TC Yasi would have financially benefited by a minimum of \$9,703 per hectare (for the average grower);
2. There are a number of financial and non-financial benefits to individual growers and industry by promoting the greater adoption of crop scheduling management strategies;

3. The lack of adoption of crop scheduling strategies by growers is in part due to:
 - a. Risk aversion
 - b. Financial resources of growers – that is, growers are pressured to generate cashflow as soon as possible after a cyclone.
Communication of information such as that generated in this report to these parties may assist in this situation.
 - c. Worker availability in some instances.
 - d. Psychological impacts of cyclone where growers lost motivation.
 - e. Lack of knowledge of the productive and financial consequences of undertaking multiple crop management activities.

7 EXTENSION AND COMMUNICATION

Significant extension and communication activities have been associated with this project as it has developed. The activities are listed below:

1. 7/8 April 2011, Cyclone recovery shed meetings, Tully and Innisfail – 120 growers and other service industry attendees across 4 meetings.
2. 17 June 2011, Cyclone recovery field trial farm walk, South Johnstone – 23 growers attending.
3. 29 Nov 2011, Cyclone recovery field trial farm walk, South Johnstone – 25 grower and consultants attending .
4. 24 May 2012, DAFF Qld Ministerial visit and field walk, South Johnstone.
5. 24 Aug 2012, Horticulture Australia Ltd, Banana levy payers annual meeting, South Johnstone – 30 grower, ABGC and HAL attendees.
6. 8 Nov 2012, Cassowary Coast Banana Growers Association meeting, El Arish – 35 banana growers attending.
7. 9 Nov 2012, Cyclone recovery seminar and field trial farm walk, South Johnstone – 50 banana growers and consultants attending.

In addition written material outlining the project results has been contributed to the ABGC newsletters and Australian Bananas magazine, and media interviews were conducted with ABC Radio rural reporters and Seven Network Regional TV news.

8 FUTURE RECOMMENDATIONS

The report authors make the following future recommendations to the ABGC in relation to scheduling banana production after tropical cyclones.

8.1 DATABASE OF CROP PRODUCTION SCHEDULES

Generally growers have only a general knowledge of the timing impact that the various crop management strategies has on single and multiple crop cycles. For instance, a grower will know that if he/she plants in October that the primary harvest will commence in October the next year but no greater level of specifics beyond this.

There are however a number of growers who do compile this information and who if approached may be willing on an anonymous basis to make this information available to industry. By creating a database of cropping production timetables over time, growers are then, if they are prepared to use the information, be better informed in terms of the impacts that various crop management techniques will have on production.

Other potential contributors may be consultants who actively work in the crop management field.

This information may then become available to those growers who become members of the ABGC.

8.2 FURTHER COMMUNICATION

1. A synopsis document of 2 pages is prepared as an insert to industry magazines which can then be 'put up' by growers in a prominent location as a reminder each harvest season.
2. DAFF and / or ABGC on multiple occasions prior to the commencement of the cyclone season promote the benefits of crop management strategies. This should be done using a combination of radio and articles in magazines.
3. Communication of the existence of a detailed budgeting tool, available through the ABGC is made known via articles in magazines.

9 ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the financial contribution of the Queensland and Commonwealth Governments through the Rural Resilience Program of the Natural Disaster Relief Arrangements that made this project possible. We also thank the Australian Banana Growers Council for their support and assistance in developing the proposal and contracting and administration of the project with the funding organisation.

Additionally we thank Horticulture Australia Ltd who supported the suggested changes from the original BA09038 project to include the post-cyclone staggered cropping program trial when the original trial was destroyed by TC Yasi. DAFF Queensland also directly supported this project through the involvement of research and development staff based at South Johnstone Research Station.

Further, the authors especially wish to acknowledge the generous contribution of a number of banana growers who contributed their valuable time, agronomic and business information. Unfortunately, we are unable to identify these contributors due to the confidential nature of the information they provided but these contributions have provided significant information about the practical implications of adopting some of the practices investigated in this project. Their contribution has been invaluable.

10 PHOTO LIBRARY

Figure 23: Uniform April planting (ToP3) at South Johnstone Research Station



Figure 24: New sucker growth on nurse suckered plant at South Johnstone Research Station.



Figure 25: Canopy removal in part of block in Innisfail district – note treated plants on right hand side compared to untreated plants on left hand side



Figure 26: Grower shed meeting Innisfail district outlining staggered cropping proposal, April 2011.



Figure 27: Grower meeting at DAFF South Johnstone Research Office outlining staggered cropping proposal, April 2011



Figure 28: Grower meeting at DAFF South Johnstone Research Office outlining staggered cropping proposal, April 2011



Figure 29: CR2 equivalent block on a commercial farm in Innisfail region, June 2012



Figure 30: Trial plant ready for harvest in CR1 plot in staggered cropping trial



Figure 31: Canopy removal treatment applied to trial plants as South Johnstone Research Station.



Figure 32: Canopy removal trial bunch harvest and measurement at South Johnstone Research Station.



Figure 33: Typical bunch characteristics (small bunch size and fruit) where canopy removal occurred after bunch initiation



Figure 34: Canopy removal treatment in Innisfail district – banana plant where the vegetative bud has died soon after TC Yasi



Figure 35: Plants on Tully Farm one week after TC Yasi without canopy removal



Figure 36: Canopy removal block in Tully one week after TC Yasi



Figure 37: Canopy removal block in Innisfail one week after TC Yasi



Figure 38: Grower Field Day in staggered crop trial at South Johnstone Research Trial, November 2012.



Figure 39: Early canopy removal trial. Bunch immediately prior to harvest.



Figure 40: South Johnstone Research Station Trial Plot immediately after TC Yasi



Figure 41: Canopy removal trial plot at DAFF South Johnstone Research Station.

