NORTHERN TERRITORY GOVERNMENT

DEPARTMENT OF RESOURCES

PRIMARY INDUSTRIES

ANNUAL RESEARCH ACHIEVEMENTS REPORT 2010-11

November 2011

Bibliography:

Northern Territory Government (2011). Primary Industries Annual Research Achievements Report 2010-11. Department of Resources. Technical Bulletin No. 346.

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Contents

About this report

This year our report takes a new format, a new name and a new look. It is now the Annual Research Achievements Report (2010-11) and provides a summary of research and development effort by science officers during the past financial year. The report covers current and recently completed research in the pastoral, plant industries and biosecurity sectors of primary industries in the Northern Territory (NT). It is intended as a platform to recognise and reward excellence in research, other scientific activity and publication.

The NT Agribusiness Strategy 2011-2015 highlights the following emerging opportunities for research and development among others: innovation in science and technology, improved production systems, alternative markets, climate change and a focus on food supply and food security. The strategy identified five objectives: profitable and productive agribusiness, land development, biosecurity, climate change preparedness and Indigenous participation. Each research project in this report specifically addresses at least one of these objectives.

DoR's Primary Industries' research aims to:

- *Facilitate sustainable resource management for economic development.*
- *Be innovative and non-repetitive with a focus on industry priorities.*
- *Direct effort on areas of capability and capacity within DoR.*
- *Help build and develop emerging NT industries.*

Primary industries in the NT are focused around animal and plant production. Animal production includes beef cattle, buffalo, crocodiles and horses. Plant production includes horticulture and mixed farming. Horticultural crops include fruit, such as mangoes and melons, vegetables, nursery and cut-flowers. Mixed farming includes field crops, pasture, hay and seeds, and forestry.

Our primary industries have significant links with, and contribute to, other sectors of the NT's economy, such as manufacturing, transport and storage, retail and employment. They also account for a significant proportion of the NT's non-mineral export revenue.

Comments and suggestions for improvements of future editions of this report, including content, layout and structure, are most welcome. Please send your comments and suggestions to technical.publications@nt.gov.au.

Cover Images	
Main:	Curious cattle at the Alexandria pasture spelling and stocking rate demonstration site (Casey Collier)
Bottom from left to right:	Rangeland burning trials (Caz Pettit); Crocodile on NT floodplains; Grafted snake beans (Barry Conde)
Report compilation:	Hassan Bajhau, Jason De Araujo, Cameron McConchie, Tim Schatz and Richard Weir

1 Biosecurity and Product Integrity

1.1 Tracking Skin Defects in Farmed Crocodile Skins

Contact: Cathy Shilton – Senior Veterinary Pathologist

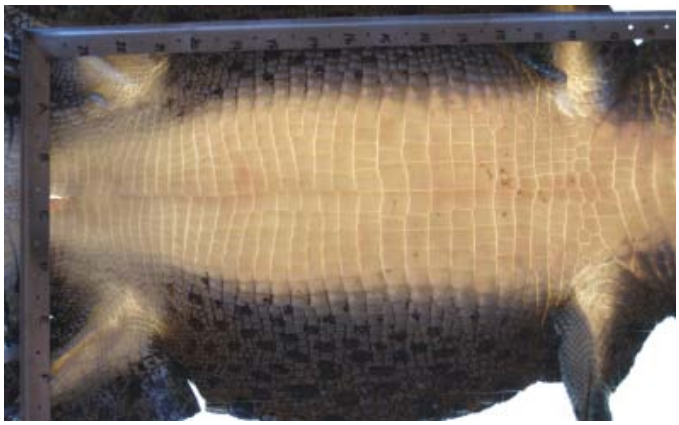
Agribusiness Industry Strategy (AIS) Reference: Strategy 1.2. Increase capacity to develop market and production intelligence.

Project Status: Continuing.

In response to a rejection of Australian crocodile skins by French tanneries in 2009 due putatively to pathological lesions from new infectious diseases, the Department of Resources established this project. Its aim is to assist the industry to determine the cause and track the lesions (which were not actually related to infectious disease) starting from the salted (raw) skin stage through to the dyed skin stage to determine when the problem occurred and why, and how to resolve it.

Below left: Collecting data on in-crust skin

***Below right*:** Raw skin on a light table



Research Outputs

In-crust crocodile skins were returned to the NT from the French tannery in 2010 to be examined in detail. Interim results were presented to the industry.

1.2 Viral and Endogenous Retroviral Detection and Characterisation in Crocodiles

Contact: Lorna Melville – OIC Berrimah Veterinary Laboratories

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

Disease investigation in crocodiles has been restricted by the limited availability of suitable cell lines in which to propagate crocodile viruses. This project aims to develop primary cell lines from crocodile tissues and then use them to investigate disease syndromes in farmed crocodiles. Wild and farmed crocodile populations will be screened for the presence of isolated viruses to determine the epidemiology of infections. With this knowledge, appropriate control measures can be developed to limit infection.

Above right and right: Harvesting crocodile embryos for cell line production

Research Outputs

Ten new cell lines were established from *Crocodylus porosus* kidney, heart, trachea and subcutaneous tissue.

More virus isolation was conducted from 70 samples of diseased crocodiles, resulting in isolating an additional 34 viruses. A total of 186 viruses have now been isolated from 599 samples. Twelve of these isolates are from *C. johnstoni* and the rest are from *C. porosus.*

Four disease syndromes have been identified. The preliminary identification results are:

Syndrome 1. *C. porosus* eye and throat infection with high mortality in juvenile crocodiles. Two isolates are herpes virus polymerase chain reaction (PCR) positive and one is negative.

Syndrome 2. *C. porosus* nodular skin lesions in harvest size crocodiles. Two isolates are PCR positive for herpes virus.

Syndrome 3. *C. porosus* poor condition or death in juvenile crocodiles with inflammation of blood vessels and the brain. Two isolates are PCR positive for herpes virus.

Syndrome 4. *C. johnstoni* systemic proliferation of immune cells (lymphocytes). One isolate is PCR negative for herpes virus and PCR positive for adenovirus.

Sequencing the product from the PCR herpes viral DNA-directed DNA polymerase was carried out at Murdoch University. The PCR was on an isolate from the syndrome which included conjunctivitis. This confirmed that the Australian isolate is a herpes virus related to, but different from, a herpes virus from an alligator in the USA.

Sera from 29 crocodiles were tested for two herpes viruses isolated from different disease syndromes. Sera comprised 16 from normal crocodiles, eight at post mortem of sick animals and five from surviving animals in the same cohort as the sick animals. The results show that the two viruses have distinctly different serological responses, indicating two different herpes viruses.

Sera from 48 farmed crocodiles and 21 wild crocodiles were tested for Kunjin (KUN) and Murray Valley encephalitis (MVE) viruses. All were negative for MVE. Thirty six farmed crocodiles and two wild crocodiles were positive for KUN.

2 Pastoral Production

2.1 Land Type Specific Sustainable Practice Guidelines for NT Pastoral Lands

Contact: Dionne Walsh – Rangeland Program Coordinator

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

The aim of this externally-funded project was to test a cost-effective method for calculating sustainable pasture utilisation rates in the Northern Territory (NT). Together with our recent development of pasture growth models, knowledge of sustainable pasture utilisation rates allows us to calculate the livestock carrying capacity of NT pastoral properties.

Below left: Mitchell grass pastures in good land condition in the Barkly Tableland region

***Below right*:** Cattle grazing at Avon Downs Station, Barkly Tableland

Research Outputs

The method was tested in 20 commercial paddocks in the Sturt Plateau, Barkly and Alice Springs pastoral regions.

The utilisation rates derived using the method were consistent with existing Department of Resources (DoR) recommendations in the Barkly and Katherine regions.

In the Alice Springs region, the method greatly overestimated utilisation rates. More research needs to be done to determine why this occurred before the method can be confidently applied in Central Australia.

Conclusions

The study confirmed that a quick and cost-effective method for deriving utilisation rates can be successfully applied in the NT.

Recommendations

Further research is required to derive appropriate top-feed availability figures for the Alice Springs region.

DoR should continue to derive pasture utilisation rates from Government research trials and from commercial properties using this method.

2.2 Developing Improved on-the-Ground Practices and Industry Strategies for Beef Production Enterprises across Northern Australia to adapt to Climate Change (Northern Grazing Systems Project Phase 2)

Contact: Dionne Walsh – Rangeland Program Coordinator

AIS Reference: Strategy 1.3 and 4.1. Develop and promote more efficient and environmentally sound production systems; Build industry capacity to adapt to the potential impacts of climate change.

Project Status: Continuing.

The first phase of the Northern Grazing Systems (NGS) project identified the four biggest grazing land management issues impacting on the profitability, sustainability and resilience of the northern pastoral industry. They are: (1) The challenge of matching pasture supply with animal demand, (2) Managing pastures in poor land condition, (3) Woody vegetation thickening and (4) Un-grazed pastures that are distant from water. Phase 2 of the NGS project will evaluate and promote promising management solutions using bio-economic modelling and on-ground demonstration sites in the Victoria River District and the Alice Springs region.

Above: A bird's eye view of the Delamere demonstration site after burning in November 2010 (Boronia Saggers)

Above right: Lush pasture growth after burning and pasture spelling during the 2010-11 wet season, Delamere Station

Research Outputs

The project has identified the most promising management options through (1) A review of grazing land management literature, (2) Scenario testing using bio-economic models and (3) Practical input from local pastoralists in each region.

A demonstration site was established to evaluate wet season spelling and prescribed burning on Delamere Station in the Victoria River Downs.

Stocking rate and pasture spelling options, which were identified in Phase 1, are to be tested at Old Man Plains Research Station.

2.3 On-farm Demonstration of Adaptation and Mitigation Options for Climate Change across Northern Australia

Contact: Dionne Walsh – Rangeland Program Coordinator

AIS Reference: Strategy 1.3 and 4.1. Develop and promote more efficient and environmentally sound production systems; Build industry capacity to adapt to the potential impacts of climate change.

Project Status: Continuing.

The aim of this project is to evaluate and promote grazing land management practices and animal productivity improvements that will increase business resilience and reduce greenhouse gas emissions intensity in the Victoria River Downs, Douglas Daly and Barkly pastoral regions. These activities represent the NT's input into a large-scale cross-jurisdictional project operating across northern Australia.

Below left: DoR Technical Officer Jodie Ward collecting pasture data at the Alexandria demonstration site (Casey Collier)

***Below bottom*:** Curious cattle at the Alexandria pasture spelling and stocking rate demonstration site (Casey Collier)

Research Outputs

Several existing benchmarking and scenario-testing tools were combined to enable the systematic evaluation of current and future animal productivity, profitability, land condition and greenhouse emissions performance of pastoral businesses.

These tools will be used to analyse the benefits, costs, emissions and practical considerations of the two common industry strategies currently being used in the northern part of the NT: (1) Breeding and growing out cattle in extensive regions in comparison with (2) Breeding in the extensive regions and growing-out on improved pastures in the Douglas Daly region.

Greenhouse gas emissions audits and soil carbon sampling were conducted on three demonstration properties in the Douglas Daly region.

A demonstration site was established on Alexandria Station in the Barkly region to evaluate wet season spelling and stocking rate management for improved climate adaptation

2.4 Guidelines for Two Rotational Grazing Strategies for Improved Land Condition and Sustainability

Contact: Chris Materne – Pastoral Production Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

This project is funded by the Natural Resource Management Board (NT) Inc. through the *Caring for Our Country* regional investments 2008-10 program. It aims to develop and promote to the industry best practice guidelines using two grazing strategies that have incorporated pasture spelling (rest) to achieve sustainable production outcomes in an arid environment. The project builds on the Desert Knowledge CRC and the Department of Agriculture Fisheries and Forestry-funded project "Central Australian Grazing Strategies Partnership" that established two grazing strategies at Mt Riddock Station and Old Man Plains Research Station (OMPRS).

Above right: Buffel grass dominated pasture under an eight-paddock rotational grazing strategy at Mt Riddock Station

Right: Woollybutt pasture under a four-paddock rotational grazing strategy on OMPRS

Research Outputs

A report was submitted to the funding body.

Draft reports for the Mt Riddock Station eight-paddock rotation and the OMPRS four-paddock rotation grazing systems were submitted to the funding body and for an internal peer review.

Draft guidelines for implementing a rotational grazing system were submitted to the funding body and for an internal peer review.

2.5 Rangeland Burning Trials - Central Australia

Contact: Chris Materne – Pastoral Production Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

This project was partly funded by the Desert Knowledge CRC's Desert Fire Program to better understand the relationships between fire, woody vegetation dynamics and pasture production through investigating the effect of Central Australia's 2000-02 fires on woodland communities.

Below left: Mature mulga plants killed by wild fires in 2002

***Below right*:** Mulga plants in a broad drainage line re-sprouting following wild fires in 2002

Research Outputs

All commitments under the Desert Fire Program were fulfilled with the submission of a paper titled "Post-fire Recruitment Dynamics of Mulga Communities in Central Australia".

2.6 Rangeland Burning Trials - Barkly Tableland

Contact: Chris Materne – Pastoral Production Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

This project is examining the benefits of using prescribed fire in the early and late dry season for managing black soil Mitchell grass plains at Alexandria Station. The first component of the project aimed to determine the impact of early and late dry season burning on pasture composition, diet quality and woody vegetation structure. The second component of the project aimed to demonstrate the application and effectiveness of prescribed fire in a commercial environment.

Above: A controlled burn on Alexandria Station

Research Outputs

A draft final report was submitted to Alexandria Station and for an internal peer review prior to publication.

Results were presented at the Helen Springs Grazing Land Management workshop in December 2010.

2.7 Developing Sustainable Carrying Capacities in the NT

Contact: Robyn Cowley – Senior Rangeland Scientist

AIS Reference: Strategy 1.3 and 4.1. Develop and promote more efficient and environmentally sound production systems; Build industry capacity to adapt to the potential impacts of climate change. (The pasture growth models developed in this project are used to model climate change impacts in other projects).

Project Status: Continuing.

The project is developing methodologies for the objective assessment of carrying capacity, including calibration of pasture growth models for the Sturt Plateau, Barkly and the Alice Springs regions to enable pastoralists to make decisions on seasonal and long-term stocking strategies.

Research Outputs

Pasture growth was measured and modelled at 39 sites across the Alice Springs, Barkly and Sturt Plateau regions.

A Technical Bulletin summarising the findings of the project is being written.

2.8 Kidman Springs Pasture Sustainability

Contact: Caroline Pettit – Rangelands Research Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

The project aims to monitor the pasture at Victoria River Research Station and to determine whether the stocking rates recommended by Cowley and Bryce (2003, DoR internal document) are sustainable. This involves determining differences between paddocks regarding pasture quality and monitoring seasonal changes.

Above right: Collecting botanal data at Kidman Springs, including species, pasture yield, cover and grazing impacts

Right: Cutting quadrats to calibrate collected data

Research Outputs

Pasture monitoring was completed on 13 paddocks in May-June 2011.

Data from 2003-11 is being analysed to determine trends in pasture yields and composition, stocking rates and pasture utilisation rates.

2.9 Shruburn

Contact: Caroline Pettit – Rangelands Research Officer

AIS Reference: Strategy 1.3 and 4.2. Develop and promote more efficient and environmentally sound production systems; Identify opportunities for primary producers to participate in the climate change economy.

Project Status: Continuing.

The project aims to investigate the efficacy of using fire to control woody thickening on pastoral land. It specifically aims to identify fire frequencies and intensities that are effective in altering or maintaining woody vegetation structure.

Below left: Dionne Walsh and Tasha McQueen burning Conkerberry paddocks, June 2011

***Below right*:** Rosewood (black soil) fire plots, June 2011 - each plot has a different fire treatment, including fire frequency and time of year burning occurs

Research Outputs

Pasture monitoring and burning regime data was completed in early 2011.

Based on the analysis of woody vegetation dynamics data collected in 2009, the following observations were made:

- The arid short grass (red soil) site had double the canopy cover (18% vs. 9%) and tree basal area (TBA) (3 m²/ha vs. 1.2 m²/ha) of the ribbon/bluegrass (black soil) site.
- Late dry season burns are required every four years to manage woody thickening in arid short grass and ribbon/bluegrass pasture communities.
- There was a significant interaction between pasture type and season of burn for canopy cover; only late dry season burns were effective on arid short grass, but both early and late dry season burns reduced canopy cover on ribbon/bluegrass sites.
- Only canopy cover results suggest that early dry season burns are effective on the ribbon/bluegrass site; however, as canopy cover is affected by recent fire (unlike TBA), this finding should be viewed with caution.
- Further analyses are required to determine if and how pasture species composition is affected by fire treatment.

Pasture dynamics, based on preliminary analysis of data from 1995-2009 indicate:

- Total standing dry matter (pasture yield) declined significantly through time regardless of burning regime (even in the control).
- *Heteropogon contortus* has increased significantly through time.

2.10 North Australian Beef Fertility Project (Cash-Cow)

Contact: Kieren McCosker – Pastoral Production Officer, Beef Cattle

AIS Reference: Strategy 1.3 and 1.2. Develop and promote more efficient and environmentally sound production systems; Increase capacity to develop market and production intelligence.

Project Status: Continuing.

The Northern Australian Beef Fertility Project (Cash-Cow) is funded by Meat and Livestock Australia. It began in 2007 and is due for completion in 2012. Approximately 70 000 cows from 78 commercial properties are included in the study.

The project aims to determine the most important factors associated with variation in reproductive performance between north Australian beef herds. Additionally, in view of the broad geographical region and management systems involved, typical and achievable levels of reproductive performance will be defined using a range of commercially meaningful measures.

Right: Data collection at Brunchilly Station, Barkly region

Below right: Cash-Cow weaner – "what are you doing?"

Research Outputs

Preliminary mob-level descriptive analyses of data have been completed from the first reproductive cycle on 71 properties. There is a wide variation in pregnancy rates and calf losses between confirmed pregnancies and weaning. The median and inter quartile range for pregnancy rates for mobs across northern Australia was 80 (63% - 86%) in maiden heifers, 75 (55% - 84%) in first lactation females and 75 (62% - 88%) in cows. The median and inter quartile range for reproductive losses between confirmed pregnancy and weaning was 10 (1% - 16%) in first lactation females and 8 (4% - 13%) in cows

2.11 Straw-Cow: Improving Reproductive Performance in Cows and Fattening Cattle in Low Input Systems of Indonesia and Northern Australia

Contact: Kieren McCosker – Pastoral Production Officer, Beef Cattle

AIS Reference: Strategy 1. 3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

The Straw-Cow project is being conducted in both Indonesia and Australia. It is funded by the Australian Centre for International Agricultural Research (ACIAR). It is a collaborative project between the Department of Resources (DoR), the University of Queensland and ACIAR. DoR is managing the Australian component of the project while also participating in the work in Indonesia.

The annual beef consumption in Indonesia is increasing by 4% while the national herd is increasing by only 1.1%. To assist in achieving future beef demands in Indonesia, smallholder enterprises need to both increase the number of breeding cows and improve reproductive performance of the breeding stock. The factors that limit the productivity of smallholder enterprises in Indonesia are similar to those affecting many pastoral systems in the Northern Territory, such as time of weaning, management of male breeding stock and managing females on low protein diets.

To improve the nutritional management of cattle during both the wet and dry seasons, the effects of nutritional changes on animal body condition, metabolism and other functions will be investigated.

Below left: Scanning the eye muscle area of a cow in the Straw-Cow project at the Katherine Research Station

***Below right*:** Cows eating rice straw in Bantur, Malang

2.12 Selected Brahmans - Improvement of the Fertility of the Brahman through the Use of Breedplan EBVs and Selection

Contact: Renee Golding – Beef Cattle Research Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

The introduction of Brahman cattle to northern Australia has resulted in large productivity gains in beef cattle due to the breed's adaptation to tropical environments. However, it is recognised that the breed has lower fertility than *Bos taurus* breeds. This project aims to improve Brahman cattle fertility and publicise the techniques that can be used to achieve this. The Department of Resources (DoR) has been selecting a Brahman herd since 1994 to improve fertility using objective selection and the genetic evaluation program Breedplan. This has involved a strict culling policy of females over two years old which fail to become pregnant, mating heifers as yearlings and selecting bulls (as yearlings) objectively based on fertility traits. Artificial insemination (AI) has been used to introduce high quality genes into the herd and AI sires are selected on estimated breeding values (EBVs) using a selection index that places a high importance on fertility traits. This project also has an extension component to increase and disseminate knowledge on objective selection techniques. An additional aim is to make high fertility Brahman cattle genes available to the industry through the sale of bulls.

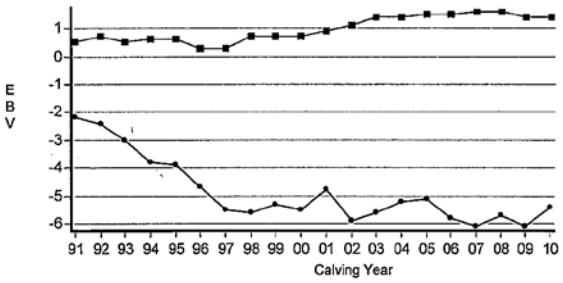


Figure 1. Days to calving EBV (days)

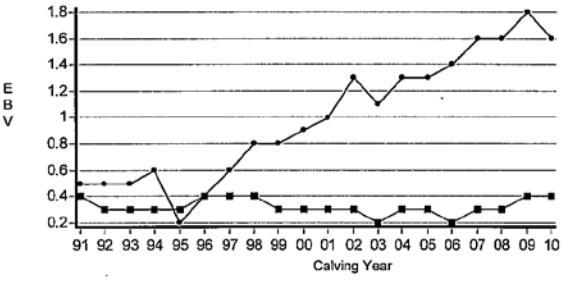


Figure 2. Scrotal size EBV (cm)

Key:
■ = Brahman breed Average
● = DoR SEL herd average

Right: Calves from the selected Brahman herd at DDRF, February 2011

Next page below: Breeders from the selected Brahman herd at VRRS, July 2011

Research Outputs

The success of this research program is reflected in improved reproductive traits, such as lower average days to calving in cows and higher scrotal circumference in bulls. EBVs for the research herd are well above the breed average for the Brahman Group Breedplan. Herd recording for Breedplan has continued. Figures for 2011 indicate that the herd continues to perform above the Brahman Group average for most EBV traits and specifically for high fertility traits (Figures 1 and 2).

Extension of this project included a Country Hour interview on ABC Radio (July 2011) and an article in MLA's *Frontier* magazine (Autumn 2011).

Due to increasing interest in this project, sire sales from this herd were high in 2010. To meet the rising demand by the industry for improved reproductive traits from the project bulls, semen production and sale are being considered.

The following notable reproductive traits were observed at round 1 muster in May 2011:

- 30% of yearling heifers (2010) were pregnant at Douglas Daly Research Farm (DDRF).
- 94% of two year-old maiden (born in 2009) heifers were pregnant at DDRF.
- 83% was the weaning rate in heifers born in 2008 at DDRF.
- 89% of wet cows born in 2008 re-conceived at DDRF.
- 87% was the weaning rate in breeders at Victoria River Research Station (VRRS).
- 92% of wet cows re-conceived at VRRS.
- 59% was the weaning rate in breeders at VRRS.
- 71% of wet cows re-conceived at Katherine Research Station.

2.13 Improving Breeder Herd Efficiency in the Arid Region with Performance Recording and Objective Selection

Contact: Jocelyn Coventry – Pastoral Production Officer

AIS Reference: Strategy 1.2. Increase capacity to develop market and production intelligence.

Project Status: Continuing.

This project is using a breeding herd of Droughtmaster cattle at Old Man Plains Research Station (OMPRS) to demonstrate benchmarking of herd performance, the use of best-practice management, techniques of bull breeding soundness evaluation, and genetic improvement through objective selection and Breedplan recording in the arid region.

Below left: OMPRS cattle manager Bryan Gill trucking off herd bulls

***Below right*:** Jocelyn Coventry (left) and Bryan Gill (right) investigating reproductive failure at OMPRS in 2011 through a post mortem examination of a Droughtmaster cow with a retained macerated foetus

Research Outputs

Reproductive performance was high in the herd during 2010-11, reflecting the excellent seasonal conditions in the Alice Springs district at that time. Of the Droughtmaster cows that had produced a calf and had been then re-mated at OMPRS in 2010-11, 74% were pregnant in May 2011. The empty cows were culled for either old age or repeated reproductive failure.

The objective selection component of this project is in its early stages. All identity records of male and female Droughtmaster cattle were submitted to the Droughtmaster Breedplan database in 2011. Estimated breeding values were calculated for 15 cows and 29 calves that were produced from artificial insemination in 2009-10.

An interim report titled 'Highlights of Droughtmaster-based Cattle at OMPRS in 2010-11' was presented at a meeting of the Alice Springs Pastoral Industry Advisory Committee on 7 March 2011.

2.14 A Comparison of Multi-breed Composite and Brahman Breeder Herd Productivity

Contact: Barry Lemcke – Principal Beef/Buffalo Research Officer

AIS Reference: Strategy 1.1. Expand market options for Territory products.

Project Status: Continuing.

This project is comparing the performance of a multi-breed composite with a Brahman herd under Top End conditions. The advantage of composites is that they can combine the desirable traits from a number of breeds and retain a greater amount of heterosis in subsequent generations than a two-breed cross. Because it contains 44% *Bos taurus* genes, the composite is likely to be more desirable in southern Australian markets than the Brahman due to its perceived better meat quality. Therefore, if the composite is found to be as productive as the Brahman under the stressful Top End conditions, it would provide more marketing options to Top End producers who have been totally dependent on the live export market in recent years. Performance is assessed through Breedplan.

Right: Brahman and composite steers at Beatrice Hill Farm

Below right: A selected composite bull at Douglas Daly Research Farm

Research Outputs

Data collection is continuing. Mean birth weight in composite calves was 29.2 kg and in Brahman calves it was 30 kg, while weaning weight was 151.3 kg and 131 kg, respectively.

2.15 Riverine Buffalo and Crossbreeding Project

Contact: Barry Lemcke – Principal Beef/Buffalo Research Officer

AIS Reference: Strategy 1.1 and 1.3. Expand market options for Territory products; Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

Riverine buffalo were imported from the USA during 1994-97. From this foundation herd, animals have now spread through all Australian states. The importation laid the foundation for the establishment of the buffalo dairy industry and the capability to expand export opportunities. Crossbreeding allowed for a greater rate of expansion using existing swamp buffalo as a base. Crossbreeding also improved growth rates for meat production by 40% compared with the swamp breed, allowing an improved product named TenderBuff resulting from a younger age animal at slaughter and therefore improved tenderness. It also allowed dairy farmers to produce milk more rapidly, using cheaper first and subsequent crosses, whilst backcrossing to the riverine breed. This project aims to build the Australian riverine buffalo population as rapidly as possible by increasing the purebred and crossbred lines to make them available to the industry. Imported Italian dairy buffalo semen has facilitated the expansion of the herd whilst avoiding inbreeding problems due to the low population base. The target is a 100 animal purebred breeder herd to turnoff around 40 heifers per year to the industry.

Below left: Cross-bred buffalo cows

***Below right*:** An Italian cross riverine bull

Research Outputs

Calf losses in 2011 were lower than in the previous year (6% in 2011 compared with 11.2% in 2010). Average calf losses over the previous four years were 8.8%. Losses due to dingoes and mis-mothering in heifers have declined markedly. Heifers were kept separately from the rest of the main breeder groups for their first calf.

Pregnancy rates in 2011 have improved compared with 2010 when they were under 50% due to a lot of late calving in February.

The newly imported semen from Italy was used to produce many bulls in 2010, which will be used in mating with the heifers for the first time in 2012. Semen from some of the 10 top bulls in Italy (ranked on genetic figures) was included in that shipment. The semen was of a much better quality than that in previous purchases and has regularly achieved the required conception rates of over 50%.

A ¾ Italian yearling bull was sold to a consortium of three Victorian Buffalo Industry Commission producers in May 2011. The local Darwin buffalo dairy commenced commercial production in November 2010 and is selling cheese to selected local independent supermarkets, restaurants and to the Coolalinga market. DoR is supplying some buffalo milking cows to increase the dairy's milk production and to obtain production figures. It is hoped that this dairy will prove that it is feasible to raise dairy buffalo in any location in SE Asia, laying the foundation for future exports of breeders to that region or elsewhere.

2.16 Enhancing Productivity Improvements in the Australian Water Buffalo Industry

Contact: Barry Lemcke – Principal Beef/Buffalo Research Officer

AIS Reference: Strategy 1.1 and 1.3. Expand market options for Territory products; Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

This project is jointly funded by the Rural Industries Research and Development Corporation and the Department of Resources. It has seven components:

1. Continue to develop artificial insemination (AI) synchronisation protocols to deliver a 50% conception rate from a single insemination.
2. Establish benchmark tenderness values for TenderBuff of various age/weight ranges.
3. Determine the quality factors in buffalo milk that distinguish it from cow's milk.
4. Continue monitoring milk testing at the Millaa Millaa dairy in Queensland to accumulate buffalo dairy production data from a commercial herd.
5. Encourage registration of producer herds throughout Australia.
6. Monitor feedlot performance of crossbred riverine buffalo overseas in comparison with swamp buffalo.
7. Prepare a best practice manual for water buffalo in Australia.

Right: A buffalo foetus viewed using real time ultrasound for early detection of pregnancy

Next page bottom: Local buffalo cheese now available in Darwin

The AI program at Beatrice Hill Farm during 2010-11 consolidated previous experience. Five rounds of AI were conducted: in July, September, November, December, 2010 and a final round in June 2011. The July 2010 and June 2011 rounds used the Ovsynch synchronising protocol (breeding season) and the other three used the Cue-Mate (out-of-season) protocol.

Milk testing for this project ceased at the Millaa Millaa dairy in June 2011. In 2010-11, eight tests were conducted in June, September, October, November 2010 and in January, February, April and June, 2011.

Research Outputs

The above AI program resulted in 15 pregnancies out of 29 (52%), nine out of 14 (64%), three out of six (50%) and two unconfirmed out of six, respectively for rounds one to four. The fifth round included mostly repeat pregnancy failures using AI. It is pleasing to consistently achieve a 50% pregnancy benchmark from AI.

TenderBuff tenderness testing results are pending.

Milk production ranged from 3.0 to 6.3 L/animal; milk protein was 4.7 to 5.4% and fat was 7.9 to 9.6%. Currently, more than 100 cows are milked daily.

The development of a buffalo registry for Breedplan is continuing with the Agricultural Business Research Institute.

The preparation of an Australian buffalo manual is continuing.

2.17 TenderBuff Development and Supply

Contact: Barry Lemcke – Principal Beef/Buffalo Research Officer

AIS Reference: Strategy 1.1. Expand market options for Territory products.

Project Status: Continuing.

TenderBuff is a registered trademark of the Northern Territory Buffalo Industry Council (NTBIC) to represent a quality-assured high value product to supply the market from a small supply base. To be accepted, an animal must comply with five specifications: 150-300 kg hot standard carcase weight, 3-12 mm of P8 fat, no permanent incisor teeth, the carcase must be electrically stimulated (or tender-stretched) and be below pH 5.8 after hanging overnight in a chiller. Local supply was restricted after 2007 due to the lack of a suitable local abattoir for slaughter. The Oenpelli abattoir (Gunbalanya Meats) has been able to provide a service but it is seasonally restricted due to a lack of wet-season access. Costs to the wholesaler have considerably increased due to rising freight and kill fees. In the Top End, the growth rates required to produce TenderBuff make it necessary to use improved pastures, or feedlots for at least two months to fatten captured feral animals to the required standard. Access to floodplain pasture in the dry season is an advantage.

Above right: Currently the only meat works available in the Top End for buffalo slaughter is at Oenpelli in western Arnhem land, 300 km from Darwin

***Right*:** Carcases at Gunbalanya Meats for sampling for tenderness in two age groups

Research Outputs

Only 15 animals were processed in 2011 due to the late opening of the meat works (10 for tenderness testing and five for the Royal Darwin Show buffalo meat stand run by NTBIC). As there is no electrical stimulation facility at Oenpelli, a TenderBuff premium price cannot be charged. Local producers eagerly wait for a decision regarding the re-opening of the Batchelor abattoir in 2011. As it is closer to producers and the Darwin market, it is likely to be more economic.

Prior to 2007, Darwin alone absorbed up to 200 buffalo carcases a year, while there were many interstate enquiries for buffalo meat. It is therefore envisaged that demand could be quickly reinstated once an abattoir is operational locally. It would also be an advantage to have a boning-out service at the abattoir, as its absence has been the greatest impediment to increased supply in recent years.

2.18 Live-weight Gain Project

Contact: Sarah Streeter – Beef Cattle Research Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

This Meat and Livestock Australia-funded project commenced in 2007 and is due for completion in 2012. The project aims to measure the factors that affect within-herd variation in weight gain in extensive Northern Territory beef herds. The factors include genetics, diseases, parasites, temperament and diet selection. The project is conducted on 11 commercial cattle properties across the Barkly, Katherine, Victoria River District (VRD) and Top End regions.

Above right: Trial steers at Legune Station, northern VRD

Right: Trisha Cowley measuring hip height of a trial steer at Walhallow Station, the Barkly region

Research Outputs

There was considerable variation in growth performance between properties, with the mean annual average daily gain in five commercial herds in 2009-10, ranging between 0.178 kg and 0.394 kg. So far, only preliminary univariate analysis has been completed on the data from these herds. Data collection was completed for five other herds in 2010-11.

Results from a pen trial at the Katherine Research Station of two diets (high and low protein) on two groups of steers, which had previously grown at 0.208 and 0.028 kg/day, respectively showed no difference in growth between the groups receiving the same diet.

2.19 Precision Pastoral Management Tools

Contact: Sally Leigo – Research Leader

AIS Reference: Strategy 1.3 and 4.1. Develop and promote more efficient and environmentally sound production systems; Build industry capacity to adapt to the potential impacts of climate change.

Project Status: Continuing.

This project aims to develop new management tools that will improve precision in cattle production on extensive rangeland pastures. The project will look at how new technology in monitoring cattle performance, pasture availability and health can be used by beef producers to improve management decisions to either increase production, decrease costs or improve efficiency.

Below: Remote livestock management system incorporating walk-over-weighing and auto-drafting units at Old Man Plains Research Station, Alice Springs

Research Outputs

An initial stakeholder engagement workshop was held in February 2011.

One-on-one consultations commenced with beef producers.

2.20 The Effectiveness of Poly Ethylene Glycol in the Utilisation of Topfeed by Cattle in Central Australia

Contact: Sally Leigo – Research Leader

AIS Reference: Strategy 1.3 and 4.1. Develop and promote more efficient and environmentally sound production systems; Build industry capacity to adapt to the potential impacts of climate change.

Project Status: Completed.

Beef producers of Central Australia requested research into poly-ethylene glycol (PEG) supplementation to determine if it could improve the performance of cattle grazing mulga (*Acacia aneura*) during severe dry periods. Previous research has found that PEG binds with the condensed tannins (found in the leaves of some plants, including mulga) allowing more protein to be digested by ruminants. An eight-week pen trial was conducted using 10 Droughtmaster heifers (average live-weight 289 kg ± 6 kg) individually penned. Five heifers received a PEG-4000 supplement (14 to 105 g PEG/animal/day for the first six weeks and 200 g PEG/animal/day for the following two weeks). The other five heifers were the control group and did not receive the supplement. To imitate the diet of cattle during severe dry periods, the animals were fed a diet consisting of 79% mulga (7.6 MJ/kg dry matter (DM) metabolisable energy (ME) and 18.2% crude protein (CP)) and 21% poor quality hay (8.4 MJ/kg DM ME and 4.9% CP).

Right: A heifer eating freshly-cut mulga during the trial

Below next page: Bulked faecal samples being prepared for analysis by Sally Sims and Bryan Gill

Research Outputs

There were no significant differences between the treatment animals in live-weight gain (mean 0.188 and 0.314 kg/day), DM intake (mean 4.2 and 4.7 kg/day) and DM digestibility (mean 48% and 50%).

There was significantly less nitrogen (N) ($p<0.001$) excreted in the faeces of PEG-supplemented heifers during the trial (1.04% of faecal DM in the PEG supplemented group and 1.36% of faecal DM in the control group).

The mean ratio between N absorbed and N consumed was significantly higher in PEG-supplemented heifers.

Recommendations

As PEG is quite expensive (currently around $7.20/kg) and as it did not have a positive effect on cattle performance in this trial, it is not recommended for use as a supplement during dry conditions in Central Australia.

It is possible that other nutrients may be required in addition to PEG to give a benefit. However, this would further increase the cost of supplementation.

2.21 Phosphorous Supplementation

Contact: Tim Schatz – Principal Pastoral Production Research Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

Despite the potential benefits of wet season phosphorus (P) supplementation, sales of P supplements across northern Australia indicate that its use is not widely adopted. Possible reasons for this include difficulties in implementation during the west season, a lack of a clear demonstration of its benefits in breeders and the absence of a simple diagnostic test for its deficiency. This project attempts to address these needs, in collaboration with the University of Queensland. It is investigating the response in cows and growing steers to P supplementation at different times of the year (wet season, dry season and all year round) and a diagnostic test for P deficiency.

Below left and right: The automatic drafter being used to draft animals into different enclosures

Research Outputs

The project is in its early stages and no results are currently available.

2.22 The Use of Alternative Tropical Breeds, Part D: Senepol Crossbreeding

Contact: Tim Schatz – Principal Pastoral Production Research Officer

AIS Reference: Strategy 1.1. Expand market options for Territory products.

Project Status: Continuing.

The stressful environment in the northern parts of the Northern Territory (NT) and in much of northern Australia means that properties have to use cattle with a high *Bos indicus* (usually Brahman) content. However, Brahman cattle have a reputation for having poor meat tenderness. While this has not been a problem in live export markets, high grade Brahman cattle are not favoured in southern Australian domestic markets. This leaves cattle producers with Brahman herds vulnerable to down-turns in the live export market. The aim of this project is to investigate whether crossbreeding Senepol bulls with Brahman cows will produce offspring that perform well under NT conditions and have better quality meat than pure Brahman cattle. If this is indeed the case, this strategy would increase marketing options for NT Brahman cattle producers as they would be able to produce suitable cattle for both the live export and Australian domestic markets. The project is comparing the performance of F1 Senepol x Brahman cattle with that of pure Brahman cattle.

Right: F1 Senepol cross Brahman calves

Below next page: Senepol bulls

Research Outputs

The first group of calves was weaned in May 2010. All males are transported to the Douglas Daly Research Farm (DDRF) to grow on improved pasture and all females are kept at Victoria River Research Station (VRRS) where their fertility will be compared with that of Brahman cattle.

On average, Senepol cross male calves were 21 kg heavier than Brahman calves at weaning and grew an extra 11 kg over the post-weaning year while grazing improved pasture at DDRF. As a result, by the end of the year after weaning, on average, Senepol cross steers weighed 32 kg more than Brahman steers.

On average, Senepol cross female calves were 14 kg heavier than Brahman female calves at weaning and put on 19 kg more than Brahman heifers over the year following weaning while grazing native pasture at VRRS. The Senepol cross and Brahman heifers will be mated at the same time at two years of age. Their fertility will be compared.

The preliminary results show that Senepol x Brahman cross cattle perform as well as, or better than, Brahman cattle. Although no meat quality studies have been conducted, it appears that because Senepol cross cattle contain 50% *Bos taurus* genes, their meat will grade better than that of Brahman cattle.

2.23 Industry Initiatives to Improve Heifer Performance in the NT

Contact: Tim Schatz – Principal Pastoral Production Research Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

This project was conducted on commercial cattle properties across the NT to document current heifer fertility levels and conduct research to demonstrate improved heifer management practices and strategies.

Below left: Performance recording at Tieyon in the Alice Springs district

***Below right*:** Maiden heifers after mating at Newry

Research Outputs

Performance recording on NT commercial properties found that:

Pregnancy rates in maiden heifers were usually adequate (>75%) to produce sufficient numbers of pregnant replacement breeders.

Pregnancy rates in lactating first-calf heifers were extremely variable (ranging from 1% to 88%), but were often below 25% on three quarters of the properties.

Calf losses in first-calf heifers were often high, averaging about 22%.

There is a strong relationship between the weight of lactating first-calf heifers and the proportion that re-conceive.

Manager surveys provided a picture of how heifers are currently managed on NT cattle stations.

Heifer demonstration sites conducted at Newry (Victoria River Downs) and Tieyon (Alice Springs region) had improved management practices.

Economic modelling improvements in heifer fertility could increase the gross margin of NT cattle properties by $10.95 million.

Conclusions

This project found that while fertility is usually adequate in maiden heifers mated for the first time at two years of age, there is room for improvement in first-calf heifer fertility.

The research showed that while first-calf heifer fertility is often low on NT cattle stations, high fertility is achievable where first-calf heifers are in good condition at calving and through lactation.

Surveys showed that this project increased the awareness among producers of the problem of low fertility in first- calf heifers and the key role of live-weight/body condition in improving it.

Recommendations

1. Segregate heifers for targeted management (such as specific supplementation) to ensure that pregnancies occur at the best time of year.

2. Weight is the biggest factor affecting conception rates; so manage heifers to be in good condition during joining.

3. Ensure that heifers grow well from weaning through until joining, as such heifers reach puberty at a younger age.

4. Heavier heifers usually conceive earlier in the joining period and this increases their chances of re-conception as first-calf heifers. For this to occur, heifers need to have reached puberty early in the joining period. Therefore, aim for a target joining weight of 280 kg in maiden Brahman cross heifers (300 kg in pure Brahman heifers).

5. Consider appropriate vaccination programs. All stock should be vaccinated against botulism. The benefits of vaccination against vibriosis, pestivirus and leptospirosis may vary from property to property, depending on conditions.

6. Supplementation to improve body condition prior to calving increases re-conception rates but its profitability depends on the cost of the supplementation.

7. A target pre-calving weight of about 440 kg is required to ensure re-conception rates of 50% in first-calf heifers. If heifers are not weighed, a condition score of 3.5 (on the 1-5 body condition score system) is a good target.

8. Weaning preserves heifer body condition, which results in higher future re-conception rates.

2.24 Cell Grazing of Improved Pastures for Increased Beef Production and Soil Carbon Sequestration

Contact: Tim Schatz – Principal Pastoral Production Research Officer

AIS Reference: Strategy 1.3 and 4.2. Develop and promote more efficient and environmentally sound production systems; Identify opportunities for primary producers to participate in the climate change economy.

Project Status: Continuing.

This project is being conducted at the Douglas Daly Research Farm (DDRF) to compare the effects of set-stocking and cell grazing regimes on animal and pasture production, pasture composition and sequestration of soil organic carbon. The treatments include: a) cell grazing (CELL), b) set stocking constantly at the long-term safe carrying capacity (SSC) and c) set stocking at a variable stocking rate that is set to be the same as the effective stocking rate in CELL (SSV).

Young cattle join this trial shortly after weaning and remain in it for about one year at which time they are replaced by the following year's weaners. The large group of CELL animals rotate around 26 6-ha paddocks while the SSC and SSV animals always stay in their 6-ha paddocks. Studies on the effects of different grazing regimes are long-term in nature as it takes some time for the effects of the grazing strategies to be evident in the pasture and the soil. This study has been running for only two years. As such, the results are preliminary.

Soil samples are tested for soil organic carbon (SOC) during the end of the dry and wet seasons.

Above right: Soil sampling at DDRF

Right: CELL group

Research Outputs

Results so far are showing that animal performance is highest in the CELL group with the lowest stocking rate.

In the first year, the results were somewhat confounded by buffalo flies impacting more on CELL animals than on the other groups due to the higher density of CELL animals. In the first year, stocking rates were as follows: CELL 1.1 animal equivalent (AE)/ha, SSV 1.1 AE/ha and SSC 1.3 AE/ha. The total average weight gain was as follows: CELL 115 kg, SSV 137 kg and SSC 133 kg.

In the second year, the stocking rates were as follows: CELL 1.4 AE/ha, SSV 1.4 AE/ha and SSC 1.3 AE/ha. The total average weight gain in each group was 161 kg, 174 kg and 186 kg, respectively. Growth was well above average in all treatments due to an exceptionally good season.

There are no apparent differences in pasture composition between treatments at this stage. In May 2011, the average total biomass in the paddocks was as follows: CELL 4460 kg/ha, SSV 4470 kg/ha and SSC 4660 kg/ha.

After two years of measurement, carbon stocks (kg C/m^3) appear to increase in cell-grazing paddocks compared with low stocked but continuously grazed paddocks, particularly in the top 10 cm of the soil.

3 Plant Industries

3.1 The Efficacy of Fungicides in Combination with Brushing for Controlling Post-harvest Diseases of Mango

Contact: Andrew Daly – Plant Pathologist

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

To examine the disease control efficacy of post-harvest fungicide (Scholar® and Sportak®) application as a spray in combination with brushing at ambient temperature.

Below left: Mangoes ripening at 20 °C for disease assessment following postharvest treatment

***Below right*:** Trays of mangoes demonstrating a comparison between the disease intensity of untreated (left) and treated (right) fruit

Research Outputs

The use of either Scholar at the rate of 1.3 or 2.6 mL/L and Sportak at the rate of 0.55 mL/L as ambient temperature sprays in combination with brushing effectively reduced anthracnose.

Brushing with water alone also significantly reduced anthracnose.

The most effective treatment for reducing total disease (anthracnose plus stem end rot) at seven days after ripening was brushing and a Scholar spray at the rate of 2.6 mL/L at ambient temperature.

No treatment reduced stem end rot completely.

Conclusions

Scholar, applied as an ambient temperature spray at the rate of 2.6 mL/L in combination with brushing, is an effective alternative to Sportak (current NT industry standard) for prolonging shelf life by controlling post-harvest anthracnose disease.

Recommendations

The use of brushing requires further investigation as it may potentially reduce the need for fungicides.

3.2 Diagnostic Protocols for Exotic Moths

Contact: Lucy Tran-Nguyen – Senior Molecular Scientist

AIS Reference: Strategy 3.2. Increase community awareness of biosecurity.

Project Status: Completed.

The use of DNA barcoding technology helps to supplement morphological identification, achieve faster identification of pests at the larval stage, accrue information on native species and obtain critical baseline data if an exotic pest is detected. Biosecurity has emerged as one of the most important issues globally facing many industries, including agriculture. The economic risks from invasive plant pests can potentially be in millions of dollars of lost income due to crop losses. Mango production is the largest primary industry in the Northern Territory (NT). In 2008, a borer, identified morphologically as *Citripestis eutraphera* (the mango fruit borer), was detected in mango fruit. Diagnosis was time-consuming due to the life cycle stage in which the pest was detected. This led to DNA barcoding research in the NT. The research expanded to cover several exotic pyraloid species of agricultural significance. These included *Citripestis eutraphera, Chilo auricilius, Chilo infuscatellus, Chilo partellus, Chilo polychrysus, Chilo sacchariphagus, Chilo terrenellus, Deanolis sublimbalis, Scirpophaga excerptalis, Scirpophaga nivella* and *Orthaga euadrusalis*.

Top above right: Red-banded mango caterpillar (*Deanolis sublimbalis)* (S. Eyres)

Bottom above right: Mango fruit borer (*Citripestis eutraphera*) (L. Zhang and M. Neal)

Research Outputs

DNA barcode targeting a segment of the cytochrome oxidase I gene was obtained for *Citripestis eutraphera, Chilo auricilius, Chilo infuscatellus, Chilo partellus, Chilo polychrysus, Chilo sacchariphagus, Chilo terrenellus, Deanolis sublimbalis, Scirpophaga excerptalis, Scirpophaga nivella* and *Orthaga euadrusalis.*

Conclusions

The diagnostic protocols for all the moths listed above are ready. Once peer-reviewed, they will be available nationally for diagnostic purposes.

DNA barcodes provide critical data to quickly identify a potentially damaging detected pest to local industries.

Recommendations

Expand the DNA barcoding database to include local insects in order to obtain baseline information to eliminate native species.

3.3 Mango Root DNA Detection – A New Tool for Applied Research

Contact: Lucy Tran-Nguyen – Senior Molecular Scientist

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

Evaluate the potential use of a fine-root distribution research tool to quantify mango root DNA in soil. Traditional fine root distribution study methods are time-consuming. New methods are required to facilitate the analysis of large numbers of samples to accurately characterise the fine root (≤ 2-mm diameter) distribution of tree roots. This will improve irrigation and fertiliser management practices.

***Below*:** Control soil collection, with the mango block in the background

Research Outputs

A probe and a primer were developed from 12 mango rootstock cultivars specifically for DNA extraction. Since common horticultural soils in the Northern Territory (NT) are not associated with inhibiting DNA extraction or quantification, they are suitable for this approach. When the probe and primer were used on extracts from soil samples, they (a) detected all the 11 mango cultivars tested, but not the weed or pasture species; (b) provided a relationship that would allow the quantification of root dry matter (DM) from mango DNA data; and (c) indicated that soil moisture conditions affect the extent to which dead roots could contribute to soil DNA concentrations.

Conclusions

A probe and a primer that are specific to DNA extracts from 12 mango rootstock cultivars were developed.

Recommendations

Areas that still require addressing for the use of this tool across Australia include determining if soils on which mangoes are grown outside the NT inhibit extraction (the qPCR method); developing a rapid and simple sampling method for the fine root-zone of mango trees for quantifying fine-root distribution based on the analysis of non-sieved samples; obtaining information on the effects of cultivar sequence copy number for comparing non-Kensington Pride rootstocks; developing a root DM:DNA concentration relationships for use on larger root sizes since the current method is specific to fine roots only.

Once development is completed, the tool can be used in orchard-based research. Potentially, this tool may be utilised to accurately determine the timing of new root flushes in order to target calcium applications for improved fruit quality, identify irrigation strategies that support fine root longevity and water uptake to improve the efficiency of irrigation in mango orchards, identify the effects of high density mango planting systems (300+ trees/ha) on fine root distribution and longevity in relation to fruit production, and evaluate the fine root density and distribution of mature rootstocks to identify selection traits in seedling rootstocks to accelerate rootstock selection that normally requires many years of field evaluation.

3.4 Integrated Pest Management to Enhance the Development of the Date Palm (*Phoenix dactylifera* L.) Industry

Contact: Raghu Sathyamurthy – Regional Team Leader

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

This study investigated the effect of fertiliser and irrigation in date palms on the population of date-palm scales (*Parlatoria blanchardii* (Targ.) in the southern Northern Territory (NT)). The date palm industry is presently limited to two farms near Alice Springs. Date palm scales have restricted the expansion of this industry.

Above right: Field trials on date palms at AZRI to control date-palm scales

Research Outputs

Diagnostic investigations undertaken during this study revealed that all scale insects documented over the growing season across multiple cultivars of date palms in the south of the NT were date-palm scales. This study found extremely low levels of control of this pest species by either predators or parasitoids.

Conclusions

The results highlight the need for augmentative and classical biological control methods in managing this species in the south of the NT. Such ecological methods of management may be more sustainable and potentially more cost-effective.

Recommendations

There is a need for further research to identify new predators and more effective parasitoids to control *Parlatoria blanchardii* (Targ.).

3.5 Quality Management to enhance Effective Supply Chains for Mangoes and Rambutans in Nusa Tenggara Barat (NTB), Indonesia and Australia

Contact: Brian Thistleton – Principal Entomologist

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

The project aims to develop effective and competitive supply chains to deliver high quality mangoes and rambutans to profitable, higher value markets in NTB and Australia. This will be achieved through three main strategies: (1) Improve fruit quality pre-harvest, (2) Maintain fruit quality through the supply chain (3) Develop suitable supply chain models to maintain fruit quality until the fruit reaches higher value markets. The research includes analysis of defects in mangoes and rambutans, methods to control pests and pathogens, and other factors that affect fruit quality. Trial shipments of fruit were made from Indonesia to Singapore, Hong Kong and Malaysia.

Research Outputs

The following outputs were achieved in Australia as part of this project:

Systemic soil-applied insecticides (Actara®, Confidor®) were very effective in controlling leafhoppers, scales and (indirectly) green ants. Flattids were also controlled. Treated trees had significantly higher fruit yields due to a reduction in losses caused by insects. During the 2009 mango season, no residues were found on fruit treated with 6 and 12 g Actara® per tree. Further work is in progress on soil and fruit residues. The current price of Actara® does not encourage its widespread use. There is an indication that its price may drop.

Work on pheromones for use against the mango fruit borer (MFB) and the red-banded mango caterpillar (RBMC) progressed considerably. Candidate pheromone blends have been developed for the first time for MFB and will be tested in Indonesia this season. It is clear that pheromones for RBMC are area-specific, since the pheromone developed for this pest in Australia does not attract the insect in Lombok (see the next report on MFB).

Based on the previous season's work, a robust disease control system was demonstrated using a combination of a pre-harvest treatment (azoxystrobin - Amistar® and mancozeb - Manzate®) and a post-harvest treatment (prochloraz - Sportak® or fludioxonil - Scholar®), resulting in less than 10% of fruit being infected after 18 days of storage at 20 °C. This result was particularly significant given the unusually wet weather at harvest, which usually contributes to a higher disease incidence.

Post-harvest disease control was assessed for stem-end rot using fruit from Queensland because the disease is of low prevalence in the Northern Territory (NT). It is clear that the current post-harvest chemicals (prochloraz - Sportak® or fludioxonil - Scholar®) do not control stem-end rots prevalent in Queensland. Hot water treatment is essential for control. Interestingly, stem-end rots in Indonesia (different species) are controlled with these post-harvest chemicals as a cold dip, especially in longer treatment times (2 to 5 minutes).

Initial work looked at the use of potassium nitrate to encourage early flowering. Past work showed no effect of potassium nitrate on the variety Kensington Pride. However, these trials confirmed many grower experience that two sprays at 2% potassium nitrate over a seven-day period advanced flowering and harvest by four weeks. Urea sprays failed to change the flowering date. Earlier flowering has significant quality and market benefits for the fruit in the NT.

A small rambutan trial using three rates of paclobutrazol (with or without potassium nitrate sprays) improved yield. Flowering and harvest did not occur earlier and there was no effect of potassium nitrate sprays.

In response to industry requests, a small trial looked at the effect of elevated CO_2 and condensation during storage at a range of temperatures on the incidence of skin browning. There was no effect.

Defect analysis in rambutan confirmed that fruit rots (*Botryodiplodia* and *Pestalotia*) and mites were the main causes of poor fruit quality.

The following outputs were achieved in Indonesia:

Four mango shipments from Lombok to Hong Kong, Singapore and Kuala Lumpur confirmed the viability of Indonesian mango exports, particularly the Arumanis variety.

The use of paclobutrazol continues to have a significant effect on mango production, even in a poor season. In an unusually wet year, paclobutrazol-treated trees produced reasonable amounts of fruit; untreated trees failed to produce fruit. The price of mangoes in a very low production year was high (4000-5000 Rp/kg). Treated trees flowered three times after rain at flowering had caused flowers to drop. In wetter areas, the use of paclobutrazol failed to produce fruit as happened in untreated trees. Earlier flowering was severely affected by higher than normal rainfall. The varieties Arumanis and Gedong gincu continue to show a very strong response to low doses of paclobutrazol.

Good disease control was achieved using cold dips of fludioxonil (Scholar®) and azoxystrobin (Amistar®) post-harvest. The time of dipping was significant. This is important for use in Australia. Hot water dipping at over 55 °C (with no chemicals) controlled diseases without causing significant heat damage to either Arumanis or Gedong gincu variety fruit. The treatments were assessed at ambient storage temperatures (domestic supply chains) and at 15 °C (export supply chains by sea). At ambient temperatures, shelf-life was at least seven days and at 15 °C, it was over 14 days.

In an unusually wet year, the variety Gedong gincu demonstrated its high quality by having excellent skin and high disease resistance. However, the variety is highly susceptible to fruit flies. The variety Arumanis had more quality problems in wet weather, with poor skin and a higher susceptibility to disease, especially a stem end rot fungus yet to be identified. Arumanis however, has a much greater resistance to fruit flies.

Jelly seed disorder was investigated in relation to fruit maturity. Data was also generated on the relationship between ripe brix and dry matter, which is essential for developing a minimum fruit maturity standard.

A latex control system was tested in Cirebon for local soaps that reduce latex marks.

The initial data on the effect of bagging fruit on quality showed a large economic benefit, improving quality and significantly reducing losses due to fruit borers. Issues related to the right material for fruit bags were resolved.

The use of thiamethoxam (Actara®) and imidacloprid (Confidor®) against leafhoppers failed due to unusual weather conditions resulting in poor quality crops.

A shipment of fruit from Lombok to Java was damaged by compression. Mangoes transported in cartons were more protected than those in traditional baskets.

Unusual weather conditions caused a complete failure in rambutan production in Lombok in 2010-11. The use of paclobutrazol failed to improve the situation. Cincturing rambutan trees significantly improved flowering off-season. This could have benefits in both Indonesian and Australia.

3.6 Control of Mango Fruit Borers

Contact: Brian Thistleton – Principal Entomologist

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

Mango fruit borers are caterpillars of a small moth, *Citripestis eutraphera* (Lepidoptera: Pyralidae), which bore into mangoes. They were originally described in Indonesia and have been also recorded in India. In Australia, they were originally detected in 2008 in two fruits from Darwin and Lambells Lagoon. Surveys in 2009 showed that the pest is widespread but at a low frequency in Darwin and its rural areas. The pest has now spread from Darwin to Howard Springs, Humpty Doo, Berry Springs and Acacia Hills. Surveys in Adelaide River, Pine Creek and Katherine did not find the pest. Symptoms caused by large larvae are very distinct, including the presence of holes with extruded frass, or split and damaged fruit. The project will collect more information on the biology of the pest as well as test the benefit of fenthion and dimethoate at the rates currently approved and used for post-harvest fruit-fly control. It will also investigate if a pheromone exists for the moth.

Research Outputs

Fenthion gave total control with no adults able to complete their life cycle. Dimethoate also controlled most moths, but in this case a small number did manage to reach the adult stage.

3.7 The Development of a Systems Approach for Fruit-fly Control and Market Access for NT Mangoes

Contact: Austin McLennan - Entomologist

AIS Reference: Strategy 1.3 and 1.1. Develop and promote more efficient and environmentally sound production systems; Expand market options for Territory products.

Project Status: Continuing.

To have access for its fruit in fruit-fly sensitive markets the Northern Territory, which is an endemic area for fruit flies, relies on the use of various post-harvest treatments combined with an inspection regime overseen by quarantine authorities. For interstate markets, the post-harvest treatments typically required are dips or sprays using the chemicals dimethoate or fenthion. However, international and national regulatory changes have threatened the continued availability of these chemicals for post-harvest treatment. While some non-chemical treatment methods are already in place for mangoes, many of them can affect fruit quality, and/or are expensive to use. One method that is increasingly accepted internationally is the 'systems' approach. This uses multiple methods to suppress fruit-fly populations within a production zone to a point where, in combination with other factors such as host status of the product, the risk of exporting infested fruit becomes as low as when using chemicals. In 2010, a pilot study was initiated in the Katherine region to evaluate local fruit-fly populations and the potential for exporting untreated mangoes to fruit-fly sensitive interstate markets using a systems approach. This approach is expected to safeguard and expand existing markets by developing alternative market access protocols that do not rely on the post-harvest use of insecticides, thereby also improving workplace safety and reducing costs, and enhancing the clean and green image of Katherine produce.

Below: Mango samples for testing for fruit-fly infestation

***Bottom left*:** Senior Technical Officer Mike Kahl collecting commercially-harvested mangoes for fruit-fly assessment

Bottom right: Adult female fruit flies lay their eggs into ripening fruit, where their larvae hatch and feed, causing spoilage

Research Outputs

A trapping grid was set to monitor populations of two tropical pest fruit-fly species across key mango producing areas in the Katherine-Mataranka region. Monitoring has continued since September 2010.

Over 15 000 untreated mangoes were assessed for fruit-fly infestation in the 2010 harvest season. Extremely low levels of infestation were detected, which were linked to fruit likely to have been at a more advanced stage of maturity at picking than the commercial 'hard mature green' standard. This suggests that commercial grading would have prevented infested fruit from entering the supply chain.

Preliminary evidence therefore suggests that provided they are picked at the correct stage (hard mature green) most mangoes from the varieties tested (Kensington Pride, Calypso and Honeygold) are unlikely to be infested by local fruit flies at harvest. Thus a 'systems' approach based on fruit maturity standards has the potential to replace chemical treatment as the primary method of assurance of uninfected fruit reaching interstate markets. However, further testing is required.

Based on preliminary findings, a local industry-supported project proposal on extension was submitted to HAL for funding.

3.8 Developing a Rice Production Industry in the Northern Territory through Enhanced Germplasm Selection and the Use of Commercially Viable Agronomic Practices for Sustainable Farming

Contact: Rowena Eastick – Research Scientist

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

The development of a rice industry has been attempted a number of times in the Northern Territory (NT), most recently in the mid-1980s. There is again an interest in the feasibility of developing a rice industry in the NT.

Numerous constraints were previously identified to rice production, including environmental, agronomic, logistic and marketing. They are still present. These constraints will need to be addressed through (a) the identification of a suitable rice germplasm for the Top End of the NT, (b) the evaluation of cost-effective agronomic practices to achieve commercially viable rice yields, (c) the development of sustainable farming systems incorporating wet and dry season rice rotations, and (d) the identification of the potential for local and export demand.

Research Outputs

A seed increase and varietal assessment trial of 20 rice lines was conducted under wet season conditions at Tortilla Flats. Results indicated that a further evaluation of selected varieties needs to be conducted under different production systems, namely wet season paddy rice, wet season upland rice and dry season rice.

Two rice field experiments were commenced at Katherine Research Station (KRS) to examine varietal performance over the dry season (10 varieties of upland/aerobic rice) and at Tortilla Flats (15 varieties of lowland paddy rice). One pot trial was also conducted at KRS (30 upland lines).

3.9 Best Practice IPM Strategies for the Control of Major Soil-borne Diseases of Vegetable Crops throughout Australia: Grafting and Fusarium Wilt of Snake Beans

Contact: Barry Conde – Plant Pathologist

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

Below left: Grafted snake beans

Fusarium wilt was first found in the Northern Territory (NT) in 1997 on snake beans in the Darwin rural area. It causes a devastating disease of snake beans, destroying about 55% of the crop annually. The project assessed grafting snake beans on to iron cowpeas as a method to control the disease. Isolates of the snake bean Fusarium wilt were previously described as three strains based on their colour and were characterised as races.

Research Outputs

The white and pink strains were similar, having abundant fluffy cultures. In contrast, the plum strain has flat colonies, having a distinct inner and outer zone structure. The white strain may age to a pale beige colour with a small black area in the centre or with black zones. Typically, the plum cultures begin as small colonies and age to a purple colour. There is, however, variation in colour in the plum and pink isolates, even in an individual isolate after passing once through plants. It is suggested that genetics of the plant may affect the colour of the colonies. Occasionally, the plum and the pink isolates may appear similar in colour, but are different according to colony structure. The plum colonies are always flat, whilst the pink colonies are always fluffy with abundant aerial mycelia.

The effectiveness of grafting on to the resistant iron cowpea root stock as a means of controlling Fusarium wilt was evaluated and demonstrated to snake bean growers through a series of large scale on-farm demonstrations and training.

Conclusions

This work demonstrated that:

- Grafting is advantageous in most situations where Fusarium wilt of snake beans occurs.
- It is likely better to use grafted plants rather than seedlings where infection levels are moderate to severe. Under such conditions, grafted plants are likely to yield twice as much as ungrafted seedlings.
- When disease pressure is low, the extra cost of grafting will not be matched by a similar increase in yield.

The study suggests that the three NT isolates may be different races to those found previously. It is therefore important to ensure that any resistant varieties or rootstocks imported from overseas into the NT are screened against the three local isolates.

Recommendations

Graft snake beans to combat all the three strains of Fusarium wilt where the disease is moderate to severe.

3.10 Reducing Skin Damage and Improving Post-harvest Management of Calypso Mangoes

Contact: Stuart Smith – Senior Research Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

This is a collaborative project with Queensland DEEDI. It aims to alleviate key commercial constraints to the production of Calypso mangoes. They include improving fruit appearance at harvest, reducing susceptibility to lenticel spotting in ripe fruit during and following harvest, improving fruit size (Calypso fruit tends to be small in hotter production areas), increasing the harvest period to reduce pressure on labour (Calypsos tend to have a three-week harvest period) and addressing in-transit ripening and improving fruit transport efficiency. The Northern Territory component of this project focuses on improving fruit appearance during and following harvest in the Darwin rural and Katherine regions.

Above right: A Calypso mango tree in bloom

Right: Roberto Marques, project officer from DEEDI at the Acacia Hills Farm

Research Outputs

Data was collected at harvest in September 2010. Pre-harvest data was collected for flowering, flushing and the weather in 2011.

3.11 Effects of Agriculture on Soil Quality

Contact: Stuart Smith – Senior Research Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

The maintenance of adequate nutrients in soils for vegetable production in the Northern Territory (NT) is challenging. This is due to low soil fertility and a tropical wet-dry climate with about 2 m of rain falling each wet season. Large-scale vegetable production usually occurs during the dry season. This project investigated the amount of nitrate recovered by forage sorghum (*Sorghum bicolor*) as a cover-crop sown at the start of the wet season in December, compared with plots of unmanaged weeds or herbicide-treated fallow plots with and without fertiliser. Soil samples were taken over a four-month period to a depth of 1.8 m at 30 cm intervals and were analysed for nitrate and ammonium nitrogen (N). By the end of the wet season in late March, the forage sorghum plots had the lowest nitrate-N concentration of 0.92 mg/kg due to plant uptake. The nitrate-N concentration in deeper soil in unmanaged weed plots indicated that weeds were less efficient at recovering mineralised nitrate from a depth of about 1 m compared with forage sorghum one month after establishment. Fallow plots recorded a significant increase in nitrate-N concentration due to progressive mineralisation (4.2 mg/kg in March). This information is useful for growers since it indicates that there is high nitrate-N mineralisation during the wet season and that an effective cover-crop can recover it from depth for later use in vegetable production.

Below left: Taking soil cores from the cover-crop trial, January 2011

***Below right*:** A sorghum cover-crop during the wet season

Research Outputs

A poster was presented at the International Society of Horticultural Science Conference titled "Sustainable Vegetable Production in South East Asia", which was held in Salatiga, Indonesia.

A paper was submitted to *Acta Horticulture* reporting on the above conference.

Conclusions

An effective cover-crop can recover nitrate-N from deep in the soil for subsequent use in vegetable production.

Recommendations

Grow forage sorghum as a cover-crop during the wet season to harvest mineralised nitrate-N from the soil for use in vegetable production.

3.12 The Northern Territory Mango Irrigation Survey: How Much Fruit from How Much Water

Contact: Stuart Smith – Senior Research Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

This project sought to benchmark current irrigation practices in the Northern Territory (NT) mango industry.

Information on irrigation practices was received from 17 surveyed orchard managers, who managed 25 separate properties, including two 124-ha properties with 315 482 trees. Irrigation water usage records were obtained from meter readings, records of hours of irrigation and estimates from descriptions of irrigation schedules and sprinkler application rates. As such, the amount of water actually used could only be estimated.

Research Outputs

There was no clear relationship between the amount of irrigation water applied and yield of packed fruit. This result was similar to another Australian fruit tree irrigation survey that concluded that there was little relationship between the estimated amount of irrigation water applied and yield. This implied that more than sufficient water had been applied and that yield was not limited by the water applied. This appears true in this study.

Conclusions

Compared with Queensland, NT water use efficiency (WUE) in mango production under irrigation was relatively efficient, producing 2.37 and 3.18 tonnes packed fruit/ha/ML of irrigation water for Kensington Pride and cultivar A, respectively. The average WUE value in Queensland across cultivars was 1.33 tonnes packed fruit/ha/ML. WUE is a useful tool for growers as an estimate of economic productivity.

Recommendations

A number of growers have had above average yields from low to moderate irrigation use. However, for other growers there is scope to improve the efficiency of irrigation. This could include measuring actual applications of water per tree by calibrating sprinklers, improving soil water monitoring methods, determining the appropriate maximum depth for irrigation and basing irrigation frequency and amounts on the soil's water-holding capacity. These practices should be included when designing new systems. Another way to improve WUE is to introduce in new orchards new mango cultivars that have a high fruit yield.

3.13 Integrated Management of the Vegetable Industry in the Northern Territory

Contact: Stuart Smith – Senior Research Officer

AIS Reference: Strategy 1.3. Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

The vegetable industry in the Northern Territory (NT) has a conservative turnover of $20 million out of a total of $130 million for all plant industries. Cucumbers grown under shade cloth are the most important vegetable crop valued at $7 million, annually. Other important vegetable crops include Asian cucurbits, herbs, snake beans, okra, onions and pumpkins. The vegetable industry is growing rapidly, particularly to supply local demand. At present, most vegetables are imported from interstate. Supermarkets are willing to sell local vegetables if product safety can be assured.

However, CSIRO has identified a need to improve local vegetable production practices to protect the environment and produce quality vegetables. This project aims to assist the vegetable industry to improve its economic and environmental performance. It proposes to conduct meetings in three locations to provide the NT vegetable industry with information on sustainable water use, integrated pest management and post-harvest management.

Below left: An IPM workshop at Humpty Doo

***Below right*:** A shed meeting at Humpty Doo

Research Outputs

A preliminary investigation of water use practice indicates over-watering.

A preliminary investigation of cool chain truck transport has indicated that snake beans lose quality during long trips to eastern states because of a high respiration rate.

External Recognition

The following is a summary of the 2010-11 internal and external awards and invitations to significant meetings and conferences.

Sally Leigo	The PEG trial team was nominated for DoR's 2010 Star Awards.
Barry Lemcke	Invited to attend a senior staff meeting of S. Kidman and Co. Pty Ltd.
	Attended the Katherine Pastoral Industry Advisory Committee Meetings.
	Attended the Indonesian Annual National Buffalo Seminar at Lebak Province in Java during November 2010 to present a paper on the potential role of buffalo in Indonesia's policy of national beef self-sufficiency by 2014.
Kieren McCosker	Won the North Australia Beef Research Council Young Achiever Award.
	Invited to speak at the 2011 North Australia Beef Research Update Conference.
	Invited to attend MLA's Northern Scoping Project - nutrition workshop.
	Invited to attend MLA's Northern Scoping Project - reproduction workshop.
Austin McLennan	Presented a summary of a project at a workshop on area-wide management of fruit flies and market access, October 2010.
	Presented a summary of a project at the Mango Industry Field Day, part of the Eighth Australian Mango Conference, Darwin, 18 to 21 May 2011.
	Presented a summary of a project at the DOR Mango R&D Forum, Darwin, 17 to18 March 2011.
Lorna Melville	Chaired the Australian Veterinary Association Meeting Section on Emerging Disease in the NT, in Darwin in March.
	Honorary academic appointment by the Menzies School of Health Research.
Tim Schatz	Invited to present research findings on heifers at the Cash-Cow annual meeting in Longreach and MLA webinar.
	Invited to participate in heifer management forum run by Pfizer.
Cathy Shilton	Nominated for a DoR Star Award by a crocodile farm chief scientist Sally Isberg for assisting the farm through this project.
Stuart Smith	Recognised for oral presentation at the Australasian Pacific Extension Network Conference in Armidale, NSW November 2011.
	Presented a poster at the International Society of Horticultural Science conference in Salatiga, Indonesia, 2011.

Lucy Tran-Nguyen	Convener for the Joint 18th Biennial Plant Pathology Society Conference and the 4th Asian Conference on Plant Pathology, Darwin, April 2011.
	Participated in the Exotic Termite Diagnostic workshop, Darwin, February 2011.
	Participated in the ACIAR Mango Disease workshop, Darwin, May 2011.
Dionne Walsh	Invited to present a paper at the 16th Biennial Australian Rangeland Society Conference, Bourke, NSW, September 2010.
	Invited to publish a paper in a special edition of *The Rangeland Journal*.

Staff and Students

Science Staff	Graduate Students
Biosecurity and Product Integrity	
Lorna Melville (OIC, Berrimah Veterinary Laboratories)	
Cathy Shilton (Senior veterinary Pathologist)	
Plant Industries	
Andrew Daly (Pant Pathologist)	Rachel Meldrum – PhD – University of Queensland
Rowena Eastick (Research Scientist)	Chet Kim Ngoy – Masters – University of Queensland
Austin McLennan (Entomologist)	
Raghu Sathyamurthy (Regional Team Leader)	
Stuart Smith (Senior Research Officer)	
Brian Thistleton (Principal Entomologist)	
Lucy Tran-Nguyen (Senior Molecular Scientist)	Rachel Meldrum – PhD – University of Queensland
Pastoral Production	
Jocelyn Coventry (Pastoral Production Officer)	
Robyn Cowley (Senior Rangeland Scientist)	
Renee Golding (Beef Cattle Research Officer)	
Chris Materne (Pastoral Production Officer)	
Kieren McCosker (Pastoral Production Officer – Beef Cattle)	Whitney Dollemore – Masters – University of Queensland
Sally Leigo (Research Leader)	
Barry Lemcke (Principal Beef/Buffalo Research Officer)	
Caroline Pettit (Rangelands Research Officer)	
Tim Schatz (Principal Pastoral Production Research Officer)	
Sarah Streeter (Beef Cattle Research Officer)	
Dionne Walsh (Rangeland Program Coordinator)	

Research Visitors

Visitor	Affiliation	DoR Contact
Kalpana Agnihotri	Tropical and Aquatic Animal Health Laboratory, Townsville – Arbovirus isolation and identification.	Lorna Melville
Associate Professor Stephen Anderson	Senior Lecturer in Physiology and Endocrinology, Biomedical Sciences, University of Queensland.	Kieren McCosker
Andrea Certoma	AAHL – Bluetongue serotype specific serology.	Lorna Melville
Roy Chisholm	Napperby Station.	Sally Leigo
Edward Connellan	Narwietooma Station.	Sally Leigo
Dick Dickman	Junior Scientist, Beef Cattle Research Institute, Grati, Indonesia.	Kieren McCosker
Debbie Eagles	AAHL – modelling arbovirus vector incursions from SE Asia.	Lorna Melville
Stef de Faveri	Qld DEEDI.	Austin McLennan
Roy Hall	University of Queensland – Flavivirus isolation from mosquitoes.	Lorna Melville
Dr Athol Klieve	University of Queensland/Qld DEEDI.	Sarah Streeter
	Led senior government officials from Mongolia in December 2010 on a tour around Alice Springs to look at rangeland management for cattle production. The visit was part of a World Bank-funded Sustainable Livelihoods Project.	Chris Materne
Mango Researchers Pakistan, Australia, Thailand, Sri Lanka, East Timor and the Philippines	Attended the Mango Disease workshop.	Lucy Tran-Nguyen
Emilio Martinez	University of Queensland.	Sarah Streeter
Professor Michael McGowan	Senior Lecturer in Livestock Medicine, School of Veterinary Science, University of Queensland.	Kieren McCosker

Visitor	Affiliation	DoR Contact
NABRC representatives	Tour of the Old Man Plains Research Station to highlight unique issues faced by the pastoral industry in the arid zone.	Chris Materne
National termite researchers/diagnosticians	NT visit.	Lucy Tran-Nguyen
Dr Ian Newton	Qld DEEDI	Austin McLennan
Professor Peter O'Rourke	Senior Biostatistician, Cancer and Population Studies Group, the Queensland Institute of Medical Research, Brisbane.	Kieren McCosker
Wayne Pitchford	University of Adelaide/Beef CRC.	Sally Leigo
Associate Professor Dennis Poppi	University of Queensland.	Sarah Streeter
Dr Simon Quigley	Senior Animal Research Officer at Animal Studies, University of Queensland.	Kieren McCosker
Dr Simon Quigley	University of Queensland.	Sarah Streeter
Dr Takdir Saili	Senior Scientist, Department of Animal Production, University of Haluoleo, Indonesia.	Kieren McCosker
SunRice/RRAPL researchers and interstate rice growers	NT visit.	Rowena Eastick
Greg Vidler	Singleton Station	Sally Leigo
Paul Williams	Senior Technical Officer, CSIRO, Rockhampton	Kieren McCosker

Research Service

The following is a summary of science staff participation on significant scientific, industry or policy development committees and editorial boards.

Andrew Daly	Member of the Mango Malformation working group.
	Member on the Scientific Advisory Panel on Elsinoe (citrus scab).
	Member of the HLB/ACP (citrus greening) taskforce.
Rowena Eastick	Plant Industry representative on the Weeds Risk Advisory Panel.
	Advisor for a book by the Environment Centre NT titled 'Weeds in Northern Australia'.
Austin McLennan	Registered Biosecurity Australia stakeholder able to comment on behalf of the NT on risk assessments related to applications to import and release biological control agents.
	Participant in the 'CSIRO Scientists in Schools' program. Two partnerships were established with teachers in Katherine.
	Member of the Australasia Pacific Extension Network Management Committee and Acting President since February 2011.
Chris Materne	DoR Pastoral Production Alice Springs on the Alice Springs representative Pastoral Industry Advisory Committee.
	Central Australian pastoral industry's representative on the NT Weed Risk Assessment Technical Committee.
Lorna Melville	Member, National Arbovirus Monitoring Program Technical Committee.
	NT representative at the Laboratories for Emerging Animal Disease Diagnosis and Response.
Tim Schatz	DoR's representative on the North Australia Beef Research Council.
	DoR's representative at meetings to develop the north Australian beef research priorities.
	Participant in regional Beef Research Committee meetings.
Cathy Shilton	Deputy Chair of Charles Darwin University Animal Ethics Committee.
Stuart Smith	Panelist advising the NT Controller of Water Resources.

Lucy Tran-Nguyen	Plant Pathology representative at the National Plant Health Diagnosticians workshop, June 2011.
	Senior Editor for the Australasian Plant Disease Notes Journal.
	Reviewer for the following scientific journals: *Australasian Plant Pathology, Federation of European Microbiological Societies, Plant Pathology*, *Plasmid, Annals of Applied Biology, Australasian Plant Disease Notes* and *Public Library of Sciences*.
	Member of the Scientific Advisory Panel for the Department of Agriculture, Fisheries and Forestry.
	Member of the mango malformation disease working group.
	Member of the national citrus pathology working group.

External Linkages

Industry Collaboration – details of specific collaborative industry-focused projects.
Research Collaboration - details of specific collaborative research projects or consortia.

Name	(I) Industry Collaboration / (R) Research Collaboration
Barry Conde	(R) Part of a national Horticulture Australia Limited project.
Jocelyn Coventry	(R) Discussed with Dr Brian Burns (DEEDI/CRC) and Mr John Bowler (Droughtmaster Society) to explore possible genetic linkages between the OMPRS herd and other Droughtmaster herds to improve genetic progress.
Robyn Cowley	(I) Collaborated in the Pigeon Hole Utilisation trial with CSIRO, Heytesbury Beef, DNRETAS and the University of Queensland. (R) Collaborating with CSIRO and Qld DEEDI in on-farm demonstration of adaptation and mitigation options for climate change across northern Australia. (R) Collaborating with CSIRO and Qld DEEDI to develop improved on-ground practices and strategies for beef production enterprises across northern Australia to adapt to climate change. (R) Collaborating with Greg McKeon (Qld Centre for Climate Change Excellence and David Mayer (Qld DEEDI) to improve empirical models of cattle growth, reproduction and mortality from native pastures in northern Australia. (R) Collaborating with Sandra Eady (CSIRO, Armidale) to conduct a life cycle assessment for the live cattle export trade. (R) Collaborating with CSIRO and Qld DEEDI in the Northern Beef Scoping project.
Andrew Daly	(I) Participated in the Banana Plant Protection Program 2011-2016. (R) Collaborating with the CRC for National Plant Biosecurity, on quality management of mangoes and rambutan in NTB (Indonesia) and Australia (ACIAR) and banana fusarium wilt resistance screening (University of Queensland).
Rowena Eastick	(R) Collaborating in the rice research project with SunRice/Rice Research Australia Pty Ltd (RRAPL), as a component of ACIAR's project.
Renee Golding	(I) Following an industry interest in high fertility Brahman genes, the potential for embryo transfer technology is being considered.
Sally Leigo	(I) Collaborated with the Alice Springs Pastoral Industry Advisory Committee. (R) The NT Department of Justice, Alice Springs, allowed Correctional Centre prisoners to assist in the PEG trial. (R) Collaboration has been established with Precision Pastoral, CSIRO, the University of New England, the Beef CRC, Meat and Livestock Australia, Qld DEEDI, the Department of Agriculture and Fisheries, WA and the Cooperative Research Centre for Remote Economic Participation and its research partners.

Name	(I) Industry Collaboration / (R) Research Collaboration
Barry Lemcke	(I) Honorary member of the Australian Buffalo Industry Council Board. (I) DoR representative on NTBIC. (I) Vice President for Oceania on the International Buffalo Federation.
Chris Materne	(I) Collected Swiftsynd data to calibrate the GRASP pasture growth model for Central Australian land types from Deep Well, Umbeara, Palmer Valley, Mt Ebenezer, Alcoota and Hamilton Downs stations. (I) Assisted R. M. Williams from Agricultural Holdings to produce a review of pasture growth estimates on Henbury Station.
Kieren McCosker	(R) Managing the $2.3 million MLA-funded Cash-Cow project, which is conducted across northern Australia. Others involved in the project include the University of Queensland, QDEEDI, QAAFI, AusVet Pty Ltd., Outcross Performance Pty Ltd., Chinchilla Veterinary Services, 78 commercial properties, 23 veterinarians and 35 field data collectors. (R) Collaborating scientist on a $1.6 million ACIAR-funded project titled Straw-Cow. It is being conducted in villages throughout Indonesia and at the Katherine Research Station.
Austin McLennan	(R) Member of GRDC's National Invertebrate Pest Initiative since 2008.
Lorna Melville	(I) Virus project for the crocodile industry. (R) Pfizer – Bovine ephemeral fever field virus and vaccine virus assessment. (R) Sydney University – Endogenous retroviruses component of the crocodile virus project. (R) Murdoch University – Crocodile virus project (molecular characterisation). (R) Australian Animal Health Laboratory – Arbovirus identification and characterisation of novel viruses.
Tim Schatz	(R) Project leader for a collaborative project with the University of Queensland on phosphorous nutrition.
Cathy Shilton	(I) The crocodile industry is an active participant in our project. (I) Successfully canvassed the industry to contribute funds to support an application for an Australian Research Council Linkage grant. (R) Collaboration has been initiated with Murdoch University's Veterinary Virology Department to administer our project.
Stuart Smith	(R) Collaborating with Qld DEEDI in the Calypso mango project.
Sarah Streeter	(R) The trial conducted at the Katherine Research Station in 2010 was in collaboration with the University of Queensland.

Name	(I) Industry Collaboration / (R) Research Collaboration
Lucy Tran-Nguyen	(I) Member on the panel looking to improve methods to identify *Fusarium* species associated with mango malformation disease and mango anthracnose. (I) Member on the panel studying molecular characterisation of *Fusarium oxysporum* f.sp. *tracheiphilum* from *Vigna unguiculata* subsp. *sesquipedalis.* (I) Member on the panel studying how to increase knowledge of *Fusarium oxysporum* f.sp. *cubense* in bananas. (R) CRC for National Plant Biosecurity. (R) Horticulture Australia Limited. (R) Australian Centre for International Agricultural Research.
Dionne Walsh	(I) A spelling and stocking rate demonstration trial was conducted at Alexandria Station. A collaborative project is being conducted between the North Australian Pastoral Company, DoR and the Australian Government. (I) A prescribed burning and spelling demonstration trial was conducted at Delamere Station. A collaborative project is being conducted between the Australian Agricultural Company, DoR, Team Savannah, Greening Australia and the Australian Government. (R) NT project manager for two large, multi-state collaborative projects between Meat and Livestock Australia, DoR, Qld DEEDI, WA Agriculture and Food, CSIRO and the Australian Government. (R) Represented DoR on the multi-state “Rubber Bush Scientific Advisory Committee”, which also includes the NT and Queensland pastoral industries, Charles Darwin University, Qld DEEDI and NRETAS.

Seminars and Lectures

Date	DoR Officer	Seminar/Lecture
March 2011	Andrew Tomkins	Biosecurity: The challenge and responding to it.
March 2011	Peter Stephens	Climate Change: The effect on plant industries.
May 2011	Mark Ashley	Ninti One Ltd and the Cooperative Research Center for Remote Economic Participation.

Publications

Scientific Papers, Peer reviewed and other Publications.

Bithell, S. L. and Tran-Nguyen, L. (2011). Mango root DNA detection – a new tool for applied research. NT Innovation Proof of Concept Award Final Report.

Bithell, S., Hartley, N., Martin, C., Hearnden, M., Smith, S. and Owens, G. (2011). The importance of a wet season cover crop for nitrate recovery in tropical vegetable production. *Acta Horticulture* (in press).

Bithell, S. L., Hartley, N. and Tran-Nguyen, L. (2011). Size distribution of mango roots: implications for irrigation and root studies. Northern Territory Mango Research Development and Extension workshop, March 2011.

Bithell, S. and Smith, S. (2011). A Method for Estimating Crop Irrigation Volumes for the Tindall Limestone Aquifer: Katherine, Water Allocation Plan. *Technical Bulletin* 337.

Brown, G., Shilton, C. M. and Shine, R. (2010). Measuring amphibian immunocompetence: validation of the phytohemagglutinin skin-swelling assay in the cane toad, *Rhinella marina. Methods in Ecology and Evolution* **2:** 341–348.

Cheth K., Mitchell, J. H., Eastick, R., Seng, V., Ouk, M. and Fukai, S. (2010). The effects of soil amendments and structure on minimising constraints in lowland soils for growing mungbeans and peanuts under glasshouse conditions. *In:* Food Security from Sustainable Agriculture. (Eds. H. Dove and R. A. Culvenor). *Proceedings of 15th Agronomy Conference*, 15-18 November 2010, Lincoln, New Zealand. http://www.regional.org.au/au/asa/2010/crop-production/sequence/7042_chethkn.htm

Conde, B. (2010).Fusarium wilt of Rosewood. *Agnote* I72.

Conde, B. (2011). Growing healthy snake beans. PINT Newsletter.

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Coventry, J. (2010). Heifers from OMPRS—growth in 2009. *Alice Springs Rural Review,* 44: 9-12.

Coventry, J. (2011). Buffalo fly in Central Australia. *Alice Springs Rural Review,* 45.

Daly, A. (2011). Post-harvest disease management in Darwin mangoes: Current and future options. Eighth Australian Mango Conference.

Daly, A.M. and Liberato, J. R. (2011). Efficiency of fungicide application in mango orchards for controlling post-harvest diseases. ACPP and APPS Conference.

Dita, M. A., Waalwijk, C., Mutua, P., Daly, A., Chang, P. L., Corcolon, B. M. and Kema, G. H. (2011). Detecting *Fusarium oxysporum* f. sp. *cubense* tropical race 4 in soil and symptomless banana tissues. *Promusa* (In press).

DoR-AussieGRASS Updates. (September 2010; December 2010 and March 2011). *Alice Springs Rural Review*.

DoR AussieGRASS Updates (2011). (September 2010; December 2010 and April 2011). *Barkly Beef.*

DoR (2010). Should we be thinking fire? (December 2010). *Alice Springs Rural Review.*

Eastick, R., Seng, V., Ouk, M., Chea, S., Som, S., Chea, C., Mitchell, J. and Fukai, S. (2010). Development of sustainable legume production in rice-based farming systems in Cambodia. *In:* Food Security from Sustainable Agriculture, (Eds. H. Dove and R. A. Culvenor). *Proceedings of 15th Agronomy Conference*, 15-18 November 2010, Lincoln, New Zealand

Gubala, A., Davis, S., Weir, R., Melville, L., Cowled, C., Walker, P. and Boyle, D. (2010). Ngaingan virus, a macropod-associated rhabdo virus, contains a second glycoprotein gene and seven novel open reading frames. *Virology* **30:**399(1)98-108.

Gubala, A., Davis, S., Weir, R., Melville, L., Cowled, C. and Boyle, D. (2011).Tibrogargan and Coastal Plains rhabdo viruses: genomic characterisation, evolution of novel genes and seroprevalence in Australian livestock. *Journal of General Virology*.

Hidalgo, M., Oliver, G. and Sathyamurthy, R. (2011). Economic and environmental assessment of the performance of reduced rates of two post-emergence herbicides in an arid irrigated production system in Central Australia: a pilot study. *Plant Protection Quarterly* **26(2):**49-53.

Hyndman, T. and Shilton, C. M. (2011). Molecular detection of two adenoviruses associated with disease in Australian lizards. *Australian Veterinary Journal* **89:**232-235.

Leigo, S. (2010). Should Central Australian pastoralists wean in 2010? The results are in. *Alice Springs Rural Review,* September.

Leigo, S. (2010). PEG pen trial. *Alice Springs Rural Review,* September.

Leigo, S., Walsh, D. and Quirk, M. (2010). Northern Grazing Systems project. *Alice Springs Rural Review,* 44: 9-12.

Leigo, S. (2010). PEG has no effect – Preliminary findings from PEG pen trial. *Alice Springs Rural Review*, December.

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