

Top Paddock

DEPARTMENT OF PRIMARY INDUSTRY AND RESOURCES



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Figure 1. Mango flowering

Message from the editor

It's nice to see a good solid dry season with plenty of nights below 20°C for flower induction in mangoes. Of course along with mango flowering comes the insect pests, particularly leaf-hoppers and plant-hoppers. You can see our article on the two for more information.

We also have an update on citrus canker and the movement restrictions currently in place. Even if you aren't a citrus grower, do you have a farm biosecurity plan to minimise the risk of exotic incursions? It seems like a really good time to recommend that growers look to their farm hygiene, and to prepare a farm biosecurity plan to minimise the chance of spreading exotic plant diseases. NT Quarantine officers and many industry bodies, including NT Farmers can help out with these plans, so if you have questions there are plenty of people able to give you advice.

Cheers

Editor

Top researchers at mango research and development forum



Figure 2. Mila Bristow presents at the NT Mango forum held in Darwin in May 2018

Collaboration was the theme at the recent Department of Primary Industry and Resources (DPIR) Mango Research and Development (R&D) Forum. Held in both Darwin and Katherine in early May the forum hosted several interstate researchers showcasing their collaborative research projects. The presentations gave growers access to researchers and PhD students from local and southern institutions. Presenters included Prof Kerry Walsh and Nick Anderson (Central Queensland University), Dr Hamish Campbell and Amelie Corriveau (Charles Darwin University), Dr Geoff Dickinson (Queensland Department of Agriculture and Fisheries), Raj Pandeya (Queensland University of Technology), A/Prof Andrew Robson (University of New England), Stacey Cook (University of Queensland) and Umar Muhammad (University of Tasmania) and Dr Cameron McConchie, Dr Mila Bristow and Dr Brian Thistleton from DPIR.

The forum covered a range of topics including yield forecasting with satellite imagery, sensor technologies, small orchards project and new insect pest trapping techniques.

Over 30 growers and service providers participated in the forums, with researchers and department staff joining the mango grower groups to collaborate, learn and discuss mango R&D.

As part of the forums, new extension staff from NT Farmers Association (Andrew Philip and Camilla Philip) and DPIR: Dr Matt Hall (Senior Horticulture Extension Officer, Darwin) and Dr Thilini Ekanayake (Regional Entomologist, Katherine) were introduced. According to Matt, “the forums were a great platform to engage with growers and stakeholders. Recent R&D in the agtech and orchard management spaces were discussed and are showing great potential to improve the forecasting and profitability of mango production”. For those who could not make it, or want to read more about the projects, information can be found on our website.



Figure 3. Information was on the agenda at the DPIR Mango Research Forum held in Darwin in May 2018

Introducing new staff



Figure 4. From left to right, Dr Danilo Guinto, Dr Thilini Ekanayake, and Dr Matt Hall have started work at Katherine Research Station and Berrimah Farm.

We are delighted to introduce three new staff to our Darwin and Katherine audiences:

Dr Danilo Guinto is the new research agronomist at Katherine Research Station.

Danny obtained his PhD at Griffith University and worked for a number of organisations in the Philippines, New Zealand and Samoa. His research experience includes soil fertility and soil health monitoring, environmental impact assessments, tropical agriculture and forestry. He has also worked on temperate horticultural crops including kiwifruit and pastures. He has supervised/advised postgraduate research students from the Philippines, the South Pacific and New Zealand universities.

Dr Thilini Ekanayake is the new entomologist at Katherine Research Station.

Thilini has a lot of experience with fruit fly research and a PhD on Queensland fruit fly mating system and courtship from Queensland University of Technology. During this time she found how Q flies locate their mating site and how they choose their mating partner. In addition to fruit fly research, she has a background in termite ecology.

Dr Matt Hall is the new senior extension officer in Darwin.

For the last 10 years Matt has been working with industry groups to advance their commercial interests through knowledge gained via applied research. During this time, he has worked across a range of disciplines including: agronomy, postharvest storage, nutrient labelling, soil science, entomology, market access and biosecurity. Coming from a farming background in Young, New South Wales, he has a keen interest in supporting decision making processes to advance the profitability of farming businesses.

It is great to fill these key positions. All three new additions bring new skills, ideas and enthusiasm to the Plant Industries Division.

2017 Tortilla Flats Rice Trial



Figure 5. Rice field at Adelaide River

Nick Hartley

Nick Hartley reports on the latest rice results from a long term rice improvement project at Tortilla Flats. For a number of years there has been interest to see how fragrant rice lines (Jasmine and Basmati) perform in the NT. This commodity is highly prized by rice consumers globally, potentially providing a niche market. Current DPIR rice research is driven by the high prices of international rice and the previous years of drought across south eastern Australia.

10 cultivars of fragrant rice were planted in May 2017 as part of a long term project to identify rice germplasm suitable for production in the Top End of the Northern Territory. The climate conditions in the 2017 dry season were favourable for rice, with few cooler days during the optimum plant growth stages of flowering and panicle initiation. This resulted in better grain yields due to less panicle sterility.

Sub plots were hand harvested and measurements were taken from each cultivar. Samples were threshed and then slowly dried down to preserve grain quality.



Figure 6. 2017 Rice plots at Tortilla Flats (left), machine harvesting (right).

After subsampling by hand, the remaining rice was machine harvested according to cultivar maturity to provide machine harvest yields and hand harvest yield data.

The table below compares the machine harvest and hand harvest yields for the cultivars trialled in 2017. The yields were highly variable between cultivars, the top performers far outstripping the bottom of the table, Doongara providing 6 times the yield of YUA16 when machine harvested.

Table 1: Grain yield for the 10 rice varieties grown at Tortilla, 2017 dry season.

Cultivars tested	Machine harvest Grain Yield T/Ha	Hand harvest Grain sub plots yield T/Ha	Best varietal Yield Performers.
10. DOONGARA	10.30	12.30	1
9. KYEEMA	10.0	10.70	2
8. VEIT - 1	9.20	11.30	3
3. SHERPA	8.35	10.20	4
1. LEMONT	8.10	7.40	5
6. SEN PIDAO	7.80	8.50	6
2. YRF214	7.50	9.05	7
4. YRF216	6.80	9.20	8
5. AMAROO	5.70	6.00	9
7. YUA16 - YO57	3.0	2.40	10

The second part of the equation in terms of suitability for production is the quality of the grain. Sub samples from each cultivar have been cleaned, processed and sent away for grain quality assessment.

Mimosa management in the Finnis area



Figure 7. An aerial view of the Finnis area floodplains, one year after spraying for *Mimosa pigra*

Susanne Casanova

(Western Top End Coordinator, Territory Natural Resource Management).

Top End floodplain pastoral properties have been under threat from *Mimosa pigra* for many years. *Mimosa* seeds are water-borne and can reach floodplains from sources further upstream on drainage lines and billabongs. As floodplain waters recede at the start of dry season each year, germinating seedlings become adult plants within a year, forming impenetrable thickets that produce huge banks of long-lived seeds. Seeds on the surface may germinate within a few months, but in addition, there are seeds which become buried in soil or leaf litter, and these may persist for twenty years or more, only germinating when the soil is disturbed.

In the Finnis and Reynolds River catchments the weed causes many land management problems, including reducing the grazing value of pastoral land by blocking the access of stock to pasture.

Steered by Territory Natural Resource Management, the Finnis Reynolds Catchment Group (FRCG) project has been operating since 2012, to address the problem of mimosa across the catchment. The project has engaged land managers and representatives from

pastoral properties, Indigenous rangers and the Northern Land Council, Weeds Management Branch, Litchfield National Park, NT Land Corporation and various small properties, in order to share knowledge and resources and improve land management at catchment scale.



Figure 8. Assessing the spread of Mimosa (foreground).

Funds for the project have come from the Federal Government's Biodiversity Round 1 Fund (2012-2017), the National Landcare Program, and most recently, contributions have been received from the Ichthys LNG Project and the Community Benefit Fund. Activities undertaken to date include collection of baseline data on feral pig density and aerial culling to achieve a 70% reduction in targeted pig populations, mapping of mimosa infestation in the catchment, increased establishment of biocontrol agents, fauna surveys to identify priority fauna species in the area, and annual aerial spray programs to treat large scale infestations of mimosa each wet season.

The mimosa aerial spray program has been a huge investment, with approximately \$700,000 of Australian Government funding matched dollar for dollar by the pastoral properties in the catchment, between 2013 and 2017. Where properties have participated, it has taken between three and five years to see a reduction in the amount of treatment needed in a given paddock. Expenditure of around \$90 per hectare has been needed over five years to 'reclaim' areas from thick mimosa, which equates to a floodplain pasture protection value of around \$20/hectare. Whilst treated floodplain areas continue to need ongoing annual investment to address the soil seed bank, this treatment is at a much lesser cost than the initial investment.

The group structure of the project has been an important aspect in increasing relationships and knowledge transfer between the people managing land in the catchment. A Technical Advisory Group was used in the early stages of the project, to help guide best practice weed management in the catchment and buffer against knowledge losses occurring through management staff turnover on properties.

Colin Deveraux has many years of experience with mimosa management in the Finnis area, starting on a small property on the north side of the river and transferring his knowledge from here to Twin Hill station on the broader Finnis floodplain, and to the Biodiversity Fund project. Colin emphasizes the point that successful treatment is all about timing. Aerial spray needs to occur when plants are actively growing but before flowering and seed set. Ideally, this is at the beginning of the wet season, after some rain has helped new seedlings germinate and grow up high enough that they're easy for the spray pilots to see in the pasture.

However, every wet season is different, and some years there is only a small window to get the treatments carried out with optimal timing. If you go too early, the new plants coming up can get missed, and then go a whole season and make seed before the pilot comes by again. On the other hand, you also don't want to be

spraying at the last minute with the floodwaters lapping around because plants in standing water don't die well. It is critical to perform treatments annually and never skip a year. It's also very important to keep an eye out for mimosa plants which don't die despite being sprayed, and treat these with alternate herbicides.

While all properties have their own priority areas and works programs, overall the key ingredients to successful mimosa treatment have been annual follow up prior to flowering, prevention of soil disturbance, and retention of good grass cover, including by introduced pasture species such as Olive hymenachne. On Twin Hill Station persistence has paid off, with treatment of all old growth mimosa now completed after an extensive twenty-year-long treatment program, and at nearby Labelle Downs and Welltree stations, aerial spray is being used to successfully keep central floodplain paddocks clear and push mimosa back upstream along the Reynolds River. On Finnis River Station, floodplains continue to remain clear, with treatments focussed on mimosa pockets under paperbarks, and on Tipperary station, focus is on treating all plants in the upper most parts of the Reynolds catchment, to reduce seeds coming down the river to Litchfield Station on the floodplain below.

To learn more about the Finnis Reynolds Catchment Group, visit the *Mimosa pigra* catchment plan page on the Territory Natural Resource Management website:

<http://tnrm.maps.arcgis.com/apps/MapJournal/index.html?appid=8e7970689a174f199fa9bddd0ac29e2e>

Or contact Susanne Casanova at Territory Natural Resource Management.

Susanne.casanova@territorynrm.org.au or 0438 765 979.

Territory Natural Resource Management (TNRM) is an independent not for profit organisation that works with landholders, community groups, industry and government to ensure sustainable management of our water, land, soils, plants and animals. If you have an NRM related research project or story that you would like to share at this year's TNRM conference (13th-15th November 2018), please visit the abstract submission page:

<https://www.territorynrm.org.au/tnrm-conference-abstracts>



Mixing business and leisure at the soil science conference in the Philippines

Constancio Tony Asis, Senior Research Agronomist

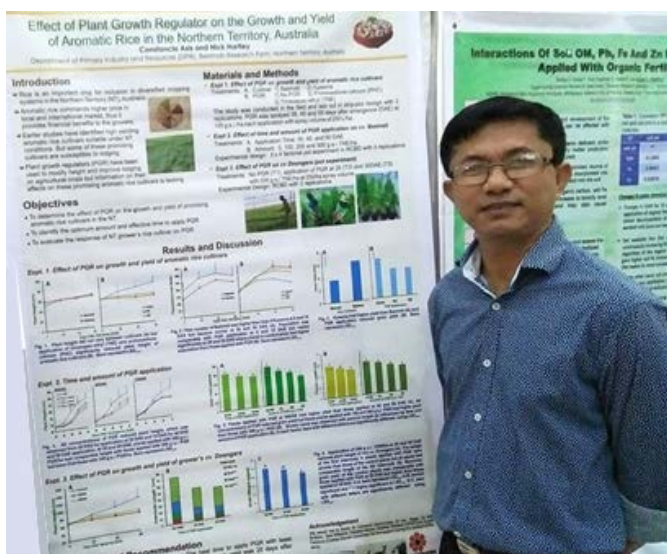


Figure 9. Left: Tony Asis with his prize winning poster at the recent 21st annual Philippine Society of Soil Science and Technology conference. Right: Tony in the field, measuring rice growth.

Recreation leave is intended to assist staff members to achieve a good life work balance. Tony Asis decided to explore the Philippines and attend a scientific conference while he was there. Tony talks about the experience and his achievement award from the Philippine Society of Soil Science and Technology (PSSST), for his notable achievements in research for the past three decades.

Conference attendance is a vital part of my professional career. It gives me opportunities to share and learn current research, ideas, and converse with other scientists. As a lifetime member of the PSSST, I received an invitation to attend its 21st annual meeting and scientific conference in May 2018. I accepted the invitation and used my recreational leave to attend.

As part of the conference I submitted a paper on ionomics and a poster titled, "Effect of plant growth regulator on growth and yield of aromatic rice". Ionomics is used as an aid in identifying the holistic dynamics of nutrient interactions. The lecture was positively received, particularly some of the details around (multivariate) statistical analysis of soil and nutrient data to avoid making false connections between nutrients. The poster, co-authored by Nick Hartley, on plant growth regulators was ranked third place in the Best Poster Award.

As part of the conference I received the Achievement Award; the highest award given by the Society. The award was in recognition of my research on an array of topics over the past 30 years. The topics include: integrated nutrient management, contribution of biological nitrogen fixation in crop production, isolation of beneficial microorganisms associated with agronomic and horticultural crops, as well as pioneering work on the use of leaf color to manage nitrogen application on rice.

After the conference, I visited the Philippine Rice Research Institute in Nueva Ecija to learn about the recent advances in rice science in the Philippines. I also went to the Philippine Nuclear Research Institute in Quezon City where I had a hands-on experience in ¹⁵N analysis using isotope ratio mass spectrometers. I was also requested to talk about ionomics to the environmental science students of Ateneo de Manila University also in Quezon City, Philippines.

Indeed, my travel was a successful use of recreation leave and I am looking forward to more opportunities to use it for the sake of science.

New *Digitaria milanjiana*

Arthur Cameron, Principal Pastures Agronomist, Darwin.

During a visit to DDRF in late November, Technical Officer Christine Hazel showed me what she thought was a new *Digitaria* in the horse paddocks at the Research Station.

I was excited to find that Chrissie had discovered a new *Digitaria milanjiana*.

In appearance, the new line appears to be a natural hybrid between Jarra and Arnhem finger grasses. It has smooth green leaves, which are narrower than those of Jarra and it produces stolons. It lacks the hairiness and purple coloration found in Jarra.

Over the years Arnhem, Jarra and Strickland finger grasses have all been planted in these horse paddocks. While Chrissie grass looks like a hybrid between Arnhem and Jarra, it could be a natural mutation from any of the 3 grasses present.

Peter Shotton from DDRF has been planting a patch of this grass on the Blain soil in the Irrigation Paddock at DDRF. We will monitor seed production from this plot and check the seed for germination next wet season.



Figure 10. New *Digitaria milanjiana*

2017 Tortilla Flats Soybean Trial



Figure 11. Soybean crop at Tortilla Flats

Nick Hartley

Soybean (*Glycine max*) has a worldwide lucrative market and may potentially be suitable as a rotation crop with rice. It has been grown in the Top End in the past and shown potential ([Agnote: Soybean production recommendations for the NT](#)). This project assessed the performance of a new cultivar grown in a raised bed cropping system.

The most critical stage in soybean production is during planting and germination. Raised beds minimise water logging and reduce seed rots. Care must also be taken when handling the seed to reduce the chance of damage affecting the crop.

For this trial, soybean was planted in rows in moist soil on each side of the beds. After germination, furrows were irrigated to just below the seed line, to sub water up to plant. Once plants have reached the four leaf stage they adapt/tolerate water lying in the bottom of furrows in the root zone.

During the vegetative stages, the crop was highly susceptible to insect pressure and a number of insect sprays were required.

A number of plots were randomly selected for hand harvesting. All samples were dried, (plant material and grain), processed and weighed. The trial was planted 27 June and harvested 120 days after sowing. On average, grain weights were 1.1 T/Ha. The trial was planted late in the season to coincide with the rice trial management and to observe the potential of soybean when grown in this system. The normal planting period for soybean is much earlier in the season, as such the later sowing dates possibly contributed to lower yields.



Figure 12. soybean on the plant

DPIR releases new mango leafhopper vs planthopper video

Planthoppers, leafhoppers, flatids..... If you are confused about these mango pests then you're not alone. Many mango growers struggle to tell the difference between the mango planthopper and the mango leafhopper. To help, the DPIR entomology branch have released a new video talking through the differences and how to identify them in your orchard.

As mango flowering season shifts into full gear, it is especially important for growers to monitor for pests in their orchard. Two important sap sucking insects on mango are mango leafhoppers and mango planthoppers, also known as flatids. These two groups of insects are quite distinct in appearance and the damage that they cause.

Mango leafhoppers, *Idioscopus nitidulus* are small cicada like insects which are most important at flowering, while mango planthoppers, *Colgaroides acuminata* are green or whitish-green in colour, hold their wings in a tent-like shape when at rest and suck sap from the shoots, flowers and fruit.

Mango leafhoppers breed all year round but produce more eggs during the flowering and fruiting period. The nymphs also develop faster during this period. Eggs hatch in 2-3 days and the development period from nymphs to adults is 12-20 days.



Figure 13. Principal entomologist Brian Thistleton discusses the differences between leafhoppers and planthoppers in the new video



Figure 14. mango leafhopper on a flower panicle.

Leafhoppers are sap suckers. Feeding and egg laying causes curling and distortion of new flush and damage to flowers. On closer examination, eggs can be seen inserted into the mid rib of the leaves and flower panicles. Leafhoppers excrete a sticky liquid known as honeydew which promotes the growth of black sooty mould. Sooty mould interferes with photosynthesis which reduces the vigour of the tree and as a result there is a decrease in yield. Sooty mould can also be caused by other common pests such as flatid planthoppers, pink wax scale, and mealybugs. When left untreated, which is often the case in home gardens or derelict mango orchards, numbers of leafhoppers build up rapidly to the extent where leaves and flowers are damaged and there is little fruit production.

Mango leafhopper populations generally increase from March onwards and this is the crucial time for growers to commence regular monitoring. Since mango leafhopper populations are able to build up very rapidly they should be treated as soon as they are detected. Regular monitoring will enable growers to detect early infestations and treat the affected trees rather than having to treat the whole orchard after they have spread.

The mango planthopper, *Colgaroides acuminata* as well as other planthoppers such as *Siphanta*, often referred to as “flatids” are pests of mangoes and other tree crops. Feeding damage is seen on the fruit stalk and skin of the fruit. Regular insect monitoring is important in the detection of this pest and treatment should be carried out before the pest reaches damaging levels.

Adults and nymphs suck sap from the shoots, flowers and fruit. Planthoppers are often seen on the fruit stalk or leaves and their feeding on the fruit stalk may cause sap to flow onto the fruit, causing sapburn.

Planthoppers excrete honeydew and an infestation will generally be indicated by the presence of sooty mould which grows on the honeydew. The presence of sooty mould may also be due to an infestation of mango leafhopper or other sap feeding insects.

The new video on mango leafhoppers and planthoppers forms part of the Growing Tips series, found on our YouTube channel. [The Growing Tips](#) channel is a series of short (five minutes or so) how to videos on a range of subjects from mango dry matters to date pollination.

For information on insect pests you can visit the NT insects database, or flip through [our field guide](#) to pests, beneficials, diseases and disorders or mangoes.

To speak to someone about management strategies, contact the entomology branch on (08) 8999 2258, or email them at insectinfo@nt.gov.au.

Follow us  on

Web: pestinfo.nt.gov.au



Figure 15. mango planthopper.

In brief: NT presence at Hort Connections 2018

Dr Matt Hall (DPIR) attended the Hort Connections conference held in Brisbane on the 18-20 June. He was joined by colleagues from the NTFA (Greg Owen, Camila Philip and Laura Cunningham) who made up the NT contingent.

This year's conference had a strong agri-tech focus with a mix of near-market and longer term technologies in the pipeline. The trade floor had close to 200 booths representing a diverse range of businesses across the supply chain.

Whilst there, Matt presented an "Update on horticulture in the Northern Territory" at the Future of Horticulture 2018 event organised by the Australian Society of Horticultural Science (AuSHS). Providing a high level overview of the industry covering the different north-south climatic regions, opportunities, constraints and the economic importance of horticulture in the NT. Matt said that

"The talk was well received as the audience weren't very aware of horticultural production in the north and the challenges it faces. They were blown away that the Northern Territory produces over half of the mangoes grown in Australia."

Having worked in the fruit export space, Matt's top pick for innovative science was Sandon Adams (Oritain, <https://oritain.com/>) presentation on scientific traceability – proving origin, protecting reputations. Oritain uses "fingerprints" which are derived from the chemical composition of plants to scientifically verify product origin. In an environment where paper and electronic records are vulnerable to tampering, isotope analysis provides scientific verification of the products origin and defends against fraud.

Matt is the Northern Territory AuSHS representative <http://aushs.org.au/>

BIOSECURITY ALERT

Citrus canker is a serious disease of citrus

PREVENT THE SPREAD OF CITRUS CANKER IN THE NORTHERN TERRITORY.

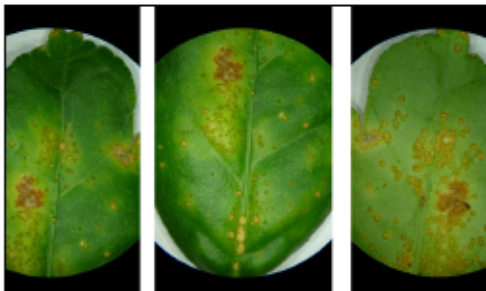
Check your citrus plants

The Department of Primary Industry and Resources (DPIR) is asking Territorians to check their citrus plants for citrus canker disease.

Citrus canker is a contagious disease of citrus and is caused by the bacterium *Xanthomonas citri* subsp. *Citri*, which can affect all citrus plants.

What to look for

- Blister like lesions on leaves, stems and fruit that are raised, tan to brown in colour, and are surrounded by an oily, water soaked and yellow ring or halo.
- Large or older lesions may have a crater like appearance.



Citrus canker symptoms on a citrus leaf



Citrus canker symptoms on citrus stem

Jeffrey W. Lotz, Florida Department of Agriculture and Consumer Services, Bugwood.org

What to do:

All Territorians with citrus plants are asked to check them for symptoms. Do not collect samples or move the plants. If you think your plants may be infected with citrus canker contact the Department of Primary Industry and Resources.

Who to contact:

- Call the citrus canker hotline: 1800 931 722
- Email: citruscanker@nt.gov.au
- Submit your photos online at: www.dpir.nt.gov.au/citrus-canker

Current as of 23 May 2018

Contact:

Citrus canker hotline: 1800 931 722
www.dpir.nt.gov.au/citrus-canker



Biosecurity Alert: Citrus Canker

BIOSECURITY ALERT

Citrus canker is a serious disease of citrus

RESTRICTIONS ON THE MOVEMENT OF CITRUS IN THE NORTHERN TERRITORY

Getting citrus canker under control

Citrus canker is a contagious disease of citrus and other related plants that has been detected in the Northern Territory. It can have a serious impact on citrus production.

In order to control the spread of this disease, restrictions on the movement of plants that can be infected with citrus canker have been put into place from 21 May 2018.

What are movement restrictions and where are they?

- The control area covers the greater Darwin area and beyond, south to Adelaide River, east to Kakadu and west to Dundee. Plants susceptible to the disease and products such as fruit and leaves are not allowed out of this area.
- Restricted areas in the greater Darwin area have also been declared around places where infected plants have been found.
- Potential host plants including citrus and related plant products such as fruit and leaves cannot be moved into, out of or moved within the restricted areas. Propagation of citrus plants is also prohibited in the restricted areas.
- These restrictions do not apply to citrus products like fruit and juice which come from outside the control area.
- Maps showing the exact borders of the control area and the restricted areas are available at: www.dpir.nt.gov.au/citrus-canker

What does this mean for me?

- Fruit remains safe to eat - citrus canker does not harm humans or animals.
- You can still buy and sell citrus fruit and juice that comes from outside the control area such as that found in most supermarkets.
- You may not take citrus plants, plant cuttings, fruit or leaves from the control area to anywhere else.
- If you live or work in one of the restricted areas, you will receive a letter about this and plant health inspectors will be visiting your property to check for plants that could be infected.
- Plant health inspectors have powers to enter properties to take samples or to remove and destroy plants that could carry citrus canker.
- If you have concerns about inspectors accessing your property or any other questions please contact the citrus canker hotline: 1800 931 722.

What to do:

All Territorians with citrus plants are asked check them for symptoms. Do not collect samples or move the plants. If you think your plants may be infected with the citrus canker contact the Department of Primary Industry and Resources.

Who to contact:

- Call the citrus canker hotline: 1800 931 722
- Email: citruscanker@nt.gov.au
- Submit photos at: www.dpir.nt.gov.au/citrus-canker

Current as of 21 May 2018

Contact:

Citrus canker hotline: 1800 931 722
www.dpir.nt.gov.au/citrus-canker



Come clean, go clean!



Guidelines for farm biosecurity

Farm biosecurity is a set of measures designed to protect properties from the entry and spread of pests and diseases. It includes trying to prevent new pests and diseases from arriving, and helping to control outbreaks if they occur.

It relies on assessing the risks of bringing pests and diseases onto your farm and how to prevent that from occurring.

Farm biosecurity is everybody's responsibility, but starts with you at the farm gate. It does not have to be complex or expensive to implement.

There are a range of **simple everyday practices** you can put in place to protect your farm and minimise the spread of pests and disease.



To protect your industry and livelihood,
help prevent the spread of unwanted
pests and diseases;

Come clean, go clean!



www.farmbiosecurity.com.au



Farm hygiene

- Pests and diseases can spread easily through soil, water and plant material in contact with people, their footwear, clothes, vehicles, machinery and equipment.
- Ensuring people, vehicles and machinery in contact with plants/crops come clean is vital in reducing the risk of introducing unwanted pests and diseases.

Remember:

- farm biosecurity is about keeping other properties clean too – ensure people, vehicles and machinery in contact with plants or **go clean**
- a footbath with decontaminant such as Agriquat, Farmcleanse® or Clorhexidine is an easy way to ensure footwear is kept clean
- visitors should use on-farm equipment, tools and boots if provided. Visitors using own equipment, should make sure it is clean before entering and exiting. 70% alcohol in a spray bottle can be used to disinfect equipment.
- crop waste can harbour pests and diseases and should be collected and disposed of away from the growing area, including crop residues and prunings, as well as packing shed waste.
- Liberal washing with soap and water can remove most infectious agents from hands and skin. Alcohol based hand-sanitisers or chlorhexidine based hand washes can also be used.

Signs and zones

- Whilst signs are not a physical barrier they should act as a clear guide.
- Never assume that all people know what to do when they arrive at your property.
- Use clear instructions and provide relevant contact details.
- Biosecurity signage should be placed at key access points, and used to direct visitors to designated parking or reception areas, and restrict access to growing areas.
- Create a map of your farm identifying the different zones. 'Outside' or 'dirty' versus 'clean', free access versus authorised personnel only.
- The growing area is in a 'clean' zone quarantined from the 'outside' zone of the farm.
- Ideally place vehicle and footbath wash bays between the 'clean' and 'outside' zones.

Training, records and registers

- Train and inform farm staff and visitors on the biosecurity measures applied on the farm to ensure pests and diseases are not unknowingly brought onto the farm.
- Training and visitor access to growing areas should be recorded.
- Recording pest and disease monitoring activities can provide useful information for tracing back or tracing forward possible pest and disease incursions on the farm.
- A register of the source of plants, with details such as variety, supplier, specific plant details (i.e. seed batch numbers) and planting dates, will help to trace back or trace forward important details if required.

Surveillance, monitoring and control

- Pest and disease surveillance involves monitoring, recording and managing pests and diseases.
- Focus on high priority areas; such as growing areas, point of access, storage areas or wash down areas. Remember some weeds can also be hosts to certain pests and diseases, so these should be controlled.
- Regular monitoring and checks of your crops can provide early warning of suspect and known pests and diseases.
- Immediate reporting of a pest or disease incursion increases efficient control.
- Do not touch, move or transport a suspected or known infected plant material. You should contact the Department of Primary Industry and Resources (DPIR) Plant Biosecurity team who will provide protocols for handling and transport of samples. Incorrect handling could spread the pest further or make samples unfit for diagnosis.



For more information on farm biosecurity visit www.farmbiosecurity.com.au or contact the DPIR Plant Biosecurity team on 8999 2118 to help get you started

REGISTRATIONS NOW OPEN

NATIONAL AWARD WINNING CONFERENCE



NORTHERN AUSTRALIA
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Northern Territory Seasonal Outlook

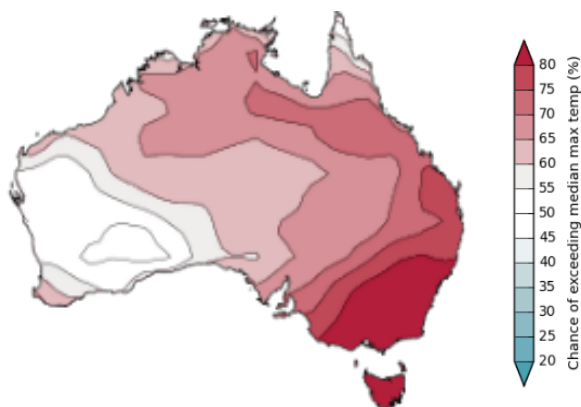
June 2018; Sourced from the Australian Bureau of Meteorology (www.bom.gov.au/climate/outlooks/)

The national outlook for July to September 2018 indicates that:

- **Drier** than average conditions are more likely across the northern half of the NT.
- In July, **drier** than average conditions are more likely across the majority of the NT.
- **Warmer** than average days are more likely across the entire NT.
- **Warmer** than average nights are more likely across the southern two thirds of the NT.

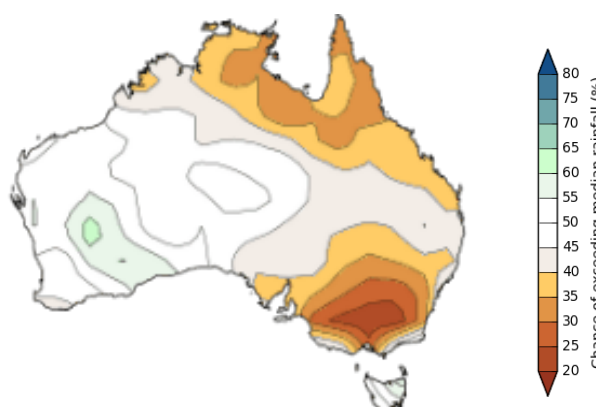
The El Niño–Southern Oscillation and the Indian Ocean Dipole are forecast to remain neutral during winter and thus have less influence on Australia's climate.

Higher than average pressures to the south of Australia persist right through the season, resulting in weaker westerlies and fewer cold fronts from the Southern Ocean, and may affect rainfall over central Australia's winter period.



Chance of exceeding the median max. temp.

July to September 2018



Chance of exceeding the median rainfall

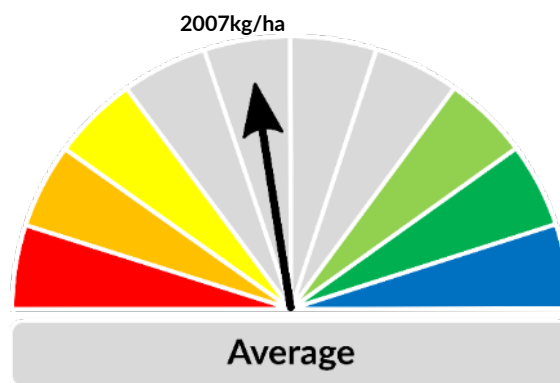
July to September 2018

Darwin District

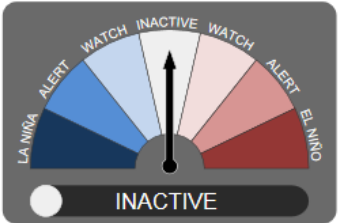
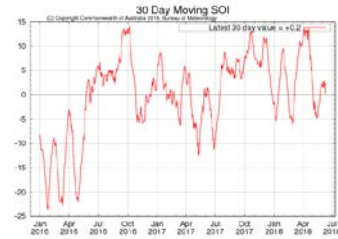
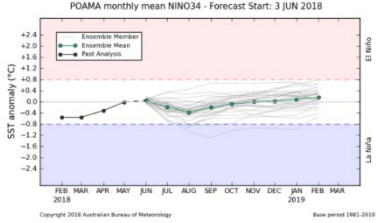

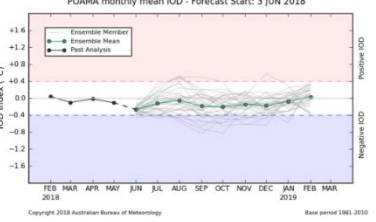
In a typical wet season, pasture growth in the Darwin region tends to be limited by available soil nitrogen rather than soil moisture.

Therefore a poor wet season may not generally affect the total quantity of pasture grown on upland country.

- After a good start to the 2017/18 wet season, pasture growth is now similar to last season and to the long-term median
- 50% of the district has been burnt since 1 July 2017 (33% of this since 1 January 2018)
- 77% of the district had a high fire risk as at 1 June 2018



2017/18 Pasture Growth

<p>Seasonal Indicators</p>	<p>Comments (sourced from the Australian Bureau of Meteorology)</p>	
<p>El Niño Southern Oscillation (ENSO)</p> <p>www.bom.gov.au/climate/enso/</p> <p>Current outlook:</p> <p>Neutral</p> <p>ENSO status:</p> 	<p>El Niño–Southern Oscillation neutral, but tropical Pacific Ocean warming</p> <p>ENSO remains neutral—neither El Niño nor La Niña. Climate model consensus indicates that ENSO will continue in a neutral phase for at least the southern hemisphere winter.</p> <p>However, sea surface temperatures in the eastern equatorial Pacific Ocean are now warmer than average, but remain well within the neutral range. Most climate models indicate some further warming of the tropical Pacific Ocean is likely in the coming months. Some models are predicting close to average, but three of the eight models reach El Niño levels during spring.</p> <p>During El Niño, rainfall in eastern Australian is typically below average during winter and spring. A neutral ENSO phase has little effect on Australian climate.</p>	 
<p>Indian Ocean Dipole (IOD)</p> <p>www.bom.gov.au/climate/enso/#tabs=indian-Ocean</p> <p>Current outlook:</p> <p>Neutral</p>	<p>IOD currently neutral</p> <p>IOD remains neutral. All six international climate models suggest it is likely to remain neutral until at least the southern hemisphere spring.</p> <p>When IOD is neutral, there is little change to Australia's climate. If negative, the warmer than average sea surface temperatures can provide more moisture for frontal systems and lows crossing Australia.</p>	 

Livestock disease investigations

The Department of Primary Industry and Resources (DPIR) provides a free disease investigation service to livestock owners for diagnosis of notifiable emergency, exotic and endemic disease, including zoonotic diseases. Berrimah Veterinary Laboratories provide free diagnostic testing for exclusion of notifiable disease for all disease investigations, and subsidies are available to private veterinarians for significant disease investigations in livestock. The Northern Australia Enhanced Disease Surveillance program has been introduced from 2017-2019 on a trial basis providing increased subsidies for cattle and buffalo disease events reported to and investigated by private veterinarians. This program recognises the higher costs and challenges associated with conducting disease investigations in more remote regions.

During January to March 2018, 55 livestock disease investigations were conducted to rule out emergency diseases or investigate suspect notifiable diseases across the Northern Territory (NT). Figure 1 shows the number of investigations by species of livestock.

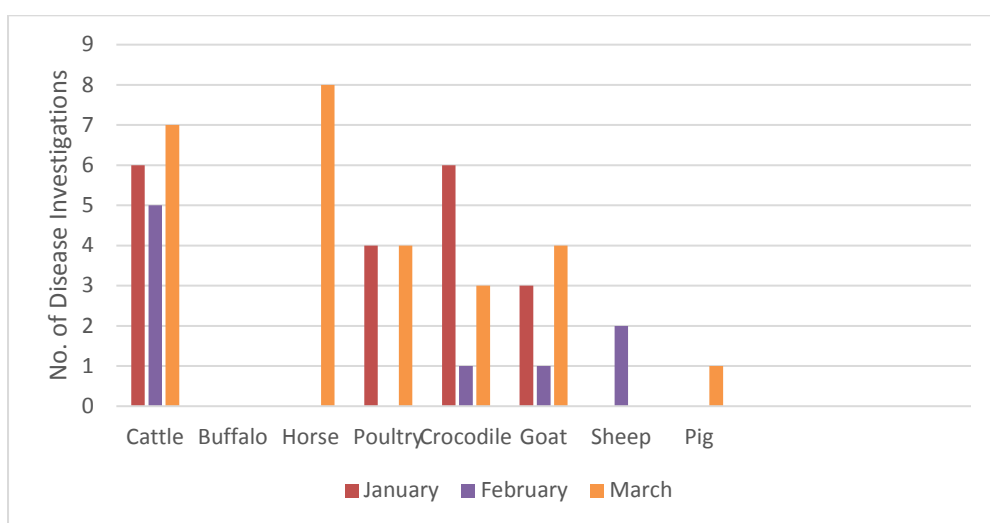


Figure 16. Livestock disease investigations by species for January to March 2018

Berrimah Veterinary Laboratories processed 119 livestock sample submissions, including samples to substantiate proof of disease freedom certifications, for accreditation programs and targeted surveillance to support market access. The following case reports are a selection of disease incident field investigations during the quarter.

Botulism in weaner cattle during the wet season

In late January a pastoral property outside of Darwin reported several cattle laying down and lethargic. The cattle were in a paddock of approximately 500 weaners. Despite supportive care, most affected animals did not improve and died within three days. Deaths continued into mid-February, with affected animals found lying down and lethargic. At least 12 head died or were euthanised.

Although the property had previously managed several cases of botulism in their cattle with vaccination, this group of cattle had not been vaccinated. A phosphorus supplement was available and the cattle had been treated for internal and external parasites using a backline treatment. Notably, the weather had been particularly wet in the previous few weeks, with the area receiving over 1000mm of rainfall for January (average of 468mm).

Initial blood and faecal sampling of an affected steer and an affected heifer showed a possible bacterial infection and mild muscle damage in both animals. The faecal egg count was within normal limits, suggesting internal parasites were not the cause. Bovine Ephemeral Fever (BEF) and polymerase chain reaction (PCR) testing for BEF virus was negative, and the BEF serological test for antibodies was positive in both animals. This indicates previous exposure, but not current infection with BEF virus. Weaner cattle within the National Arbovirus Monitoring Program activity zone commonly have antibodies against the BEF virus.

The Darwin Regional Veterinary Officer attended the property and performed an autopsy on a euthanised steer and a heifer which had died 12 hours previously. The heifer was one year old and in good condition. A fragment of bone was found in the omasum (third stomach), and a full range of samples were collected. While there was marked decomposition of the tissues of the heifer, no obvious abnormalities were observed on histology. The steer was two years old and in good condition. It had been sitting for 24 hours, was bright in demeanour and there was no evidence of tongue paralysis. Similarly, fragments of bone were found in the rumen during autopsy. This steer also displayed antibodies to BEF, though tests of splenic tissue from the heifer and blood from the steer indicated that the exposure was not recent.

Based on a combination of the clinical signs, history of botulism on the property, lack of vaccination of the affected animals, the presence of bone fragments in the gastrointestinal tract and no significant findings on microscopic histology, a diagnosis of botulism was made. Botulism toxicity is very difficult to prove conclusively but it is a major risk to NT cattle.

Given the recent wet weather and large wildlife population in the area (agile wallabies), it is likely the unvaccinated weaner cattle had access to cattle or wildlife carcasses with the botulinum toxin produced by the bacterium, *Clostridium botulinum*. The bacteria can multiply rapidly in carcasses with the warm and moist conditions of the Top End wet season and produce spores that can survive in the environment for years as a future disease threat. Despite mineral supplementation cattle will often persist in carcass consumption exposing themselves to a major source of toxin.

There is no treatment for botulism in cattle and most affected cattle are euthanised or die of respiratory failure. In this case, advice was given to immediately vaccinate the remaining cattle with botulism vaccine and to ensure that carcasses were removed from paddocks and buried or burnt where possible. Mortalities on the property ceased two weeks after the cattle were vaccinated which is possible further proof of botulism. The property has now implemented a vaccination program for future young stock.

Acute neurological disease in grower pigs fed vegetable food scraps

In late March, after several weeks of particularly wet and humid weather, a hobby farmer outside Darwin reported acute neurological disease in a litter of 3 month old grower pigs. The pigs were normal when fed in the evening, but the next morning 6 out of 10 young pigs were found lying on their sides and paddling with their legs. The six adult pigs in the same and neighbouring pens were unaffected. There had been no recent management changes on the property.

On examination, the affected pigs were somewhat aware of their surroundings, and were able to weakly struggle when restrained, but were unable to get up. They exhibited severe whole body tremors and appeared particularly sensitive to noise and movement. Two affected pigs were euthanised and autopsy was performed. Both piglets were in good body condition, with stomachs full of mixed material consisting of foetid brown mashed material including various vegetables and fine roots. Remaining intestinal tracts of both pigs were full of normal contents. The pigs were normally hydrated, with abundant urine in their bladders.



Figure 17. Recumbent pig

Blood chemistry analysis did not show any significant changes, with electrolytes, minerals and kidney and liver parameters within normal limits. Both grower pigs showed an increase in the number of white blood cells that respond to bacterial infections. On histological examination, a mild to moderate inflammation of the brain was observed in both pigs. A culture of swabs taken from the brainstem at necropsy from both pigs was negative, including in culture media specific for *Haemophilus parasuis* (Glässers Disease – which can cause convulsions), and there were no systemic lesions suggestive of septicaemia. Infection with exotic Aujeszky's Disease was excluded via testing of multiple tissue samples at the Australian Animal Health Laboratory in Geelong, Victoria.

On questioning, the owner reported that they had ceased feeding the piglets a weaner pellet ration a few weeks previously, as the stored food had become mouldy. The current ration for the piglets and adults had consisted of scrap food sourced from a local Foodbank, which was collected every three days and stored in a cool room on the property. These scraps consisted of a various types of fruit, vegetables and bread, and given the recent high humidity, it is likely some of the scraps were mouldy. This feed is permitted and is not defined as 'swill'.

Based on clinical history, histological evidence and access to feed scraps which were likely mouldy, a diagnosis of toxicity due to tremorgenic mycotoxin was made. Mycotoxins are toxic substances produced by a fungus. Tremorgens are mycotoxins which can produce tremors or seizures in animals which consume toxic amounts of contaminated foodstuff.

Advice was given to immediately discard the remaining food scraps and treat the affected pigs with supportive therapy. 24 hours after the first signs were observed, the owner was surprised to find the remaining 4 affected pigs had made a complete recovery; this is consistent with exposure to a sub-lethal dose of tremorgenic mycotoxin. The owner has since commenced feeding a commercial grower pig pellet ration and there have been no further issues on the property.

Feeding of swill - food scraps which contain meat, meat products or anything that has been in contact with meat is not permitted and can cause extoic diseases in pigs, which may also infect other livestock. Feeding swill to pigs is believed to have caused the outbreak of Foot-and-Mouth (FMD) disease in the UK in 2001.

In addition to FMD; Classical and African Swine Fever and Transmissible Gastroenteritis can be carried and transmitted by feeding swill to pigs.

If you notice any unusual symptoms in your pigs, contact your Regional Biosecurity Office to arrange investigation or report it to the Emergency Animal Disease Watch Hotline 1800 675 888.

ALERT: Akabane risk to cattle herds in Central Australia

Akabane virus causes a disease which results in abortions, stillbirth and deformities in the foetus of livestock. It primarily affects cattle and is transmitted by the biting midge (*Culicoides brevitarsis*).

In May 2018, Akabane virus exposure was detected in the sentinel cattle herd at Arid Zone Research Institute (AZRI) in Alice Springs. Akabane has not been detected in sentinel cattle in the Alice Springs region since 1974, when 60% of the sentinel cattle tested positive. At that time, insect trapping did not identify the biting midge and therefore other vectors may have been involved in the transmission of the virus between these cattle.

Since 1975, sentinel cattle at AZRI have been monitored continuously for Akabane virus exposure and insect traps have been set to monitor the presence of potential Akabane insect vectors. For the past 43 years, there has been no evidence of Akabane exposure or the presence of the biting midge, *Culicoides brevitarsis* at AZRI. This is also supported by the negative Akabane results from serosurvey cattle on pastoral properties which have participated in the National Arbovirus Monitoring Program (NAMP). Information on NAMP can be found at <https://www.animalhealthaustralia.com.au/what-we-do/disease-surveillance/national-arbovirus-monitoring-program/>

Cattle producers are being asked to monitor calves born to cows and heifers this year for any symptoms consistent with Akabane disease and to participate in the NAMP program to determine whether their herd has been exposed.

Human infection with Akabane virus has never been reported.

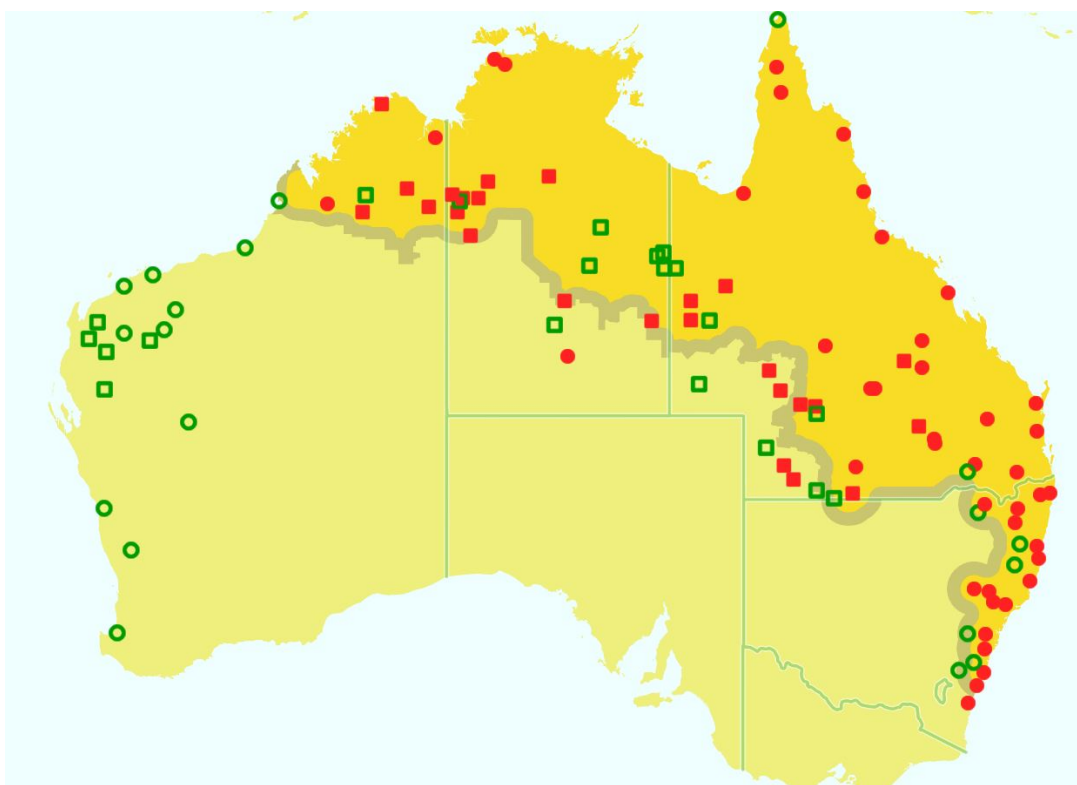


Figure 18. Akabane exposure distribution in 2016/2017 based on sentinel and serosurvey herds.

Symptoms

No clinical signs are seen in adult cattle. Infection of cattle results in a transient viraemia causing a rise in Akabane antibodies. It affects the nervous system of the foetus in pregnant females.

The disease in calves appears as:

- Abortions at any time with a combination of the following:
 - early infection of the foetus results in calves born with arthrogryposis (deficiency of the cerebral cortex part of the brain leading to congenital joint contracture in two or more areas of the body with failure of muscle development). The condition is commonly referred to as 'Crooked Calf Disease'. Hydranencephaly (replacement of brain tissue by a fluid-filled sac) may also occur.
 - infection at 3-4 months foetal age shows hydranencephaly only in calves. The condition is commonly referred to as 'Dummy Calf Syndrome'. Calves can rise and walk, but are blind, have no basic reflexes and lack intelligence.
 - infection at an older foetal age (5-6 months) results in calves with arthrogryposis (due to the failure of muscle development). These skeletal deformities in more advanced pregnancies are the first seen in an outbreak.

There may be calving problems due to calf limb deformity. When born alive, their teeth, coat and hooves are fully mature but they are small, underweight, weak and often unable to stand.

Infection and immunity before pregnancy can occur in areas where the vector is present, so no signs of the disease are seen.

If you have calves with these symptoms, contact your Regional Biosecurity office or private vet to investigate. Blood samples can be collected from other cattle in the herd to identify whether the herd has been exposed to Akabane virus.

How it is spread

The disease is transmitted by blood-feeding insects, mostly *Culicoides brevitarsis* (biting midges), but other vectors could exist. Consequently, Akabane is endemic in the northern regions of Northern Territory with a similar distribution to the Bluetongue Virus (BTV) which shares the same vector.

When suitable weather conditions allow the midges to extend their normal range into areas with susceptible animals, and these animals have not previously been infected, clinical signs may be seen in the next calving season.

Monitoring

The National Arbovirus Monitoring Program (NAMMP) monitors the seasonal distribution of not only BTV, but also Akabane virus and BEF. Younger animals (less than 18 months of age) are bled to determine the exposure of the herd in the most recent season.

Diagnosis of Akabane virus can often be made by clinical signs in the calf and can be confirmed by antibodies in the blood of the calf, cow or heifer.

Control

There are no options for treatment or control because of the nature of the disease and the method of disease spread. If Akabane is endemic in an area, breeding stock should be introduced to the area at an early age to gain immunity.

Participating in NAMP provides information about the presence or absence of the midge which transmits the Akabane virus, as well as the insect vectors for BEF and BTV. This can be used to inform the cattle industry more accurately on the location of the risk, and improve awareness for the disease and ensure that suspect cases are investigated by government or private veterinarians. The consequence of the disease on calving can have a significant economic impact on a pastoral property.

Review of the Australian Standards for Export of Livestock

The Department of Agriculture and Water Resources has commenced a review of the [Australian Standards for the Export of Livestock \(ASEL\)](#). The review will be conducted in three separate stages with each stage taking several months.

Stage 1 related to the format and content of ASEL. Nineteen submissions were received from individuals, businesses, industry, animal welfare organisations and government departments. The committee will use the submissions to recommend format improvements for the standards and set the direction for the rest of the review in Stage 2 and Stage 3.

Submissions can be viewed at <http://www.agriculture.gov.au/animal/welfare/export-trade/review-asel>

The ASEL review is important because all cattle and buffalo destined for live export must comply with ASEL. Of note, ASEL sets the identification, pregnancy testing and spaying standards for export cattle and buffalo. There has been ongoing concerns raised about cattle not being adequately identified and their pregnancy testing status being incorrectly reported. NT Government currently administers the accreditation of non-veterinarians who pregnancy test NT cattle and buffalo for export. The ASEL review provides the opportunity for feedback from stakeholders; including producers, agents, exporters and veterinarians on whether State and Territory Government agencies should be involved in the accreditation process under ASEL as well as the ability to be involved and provide feedback on any other ASEL component to influence the outcomes of the review.

ASEL supports continued live export market access, minimisation of adverse welfare outcomes and risks to industry.

Northern Australian Biosecurity Surveillance (NABS) project update

The Northern Australia Biosecurity Surveillance (NABS) project was formed in 2016 with funding from the Australian Government Agricultural Competitiveness White Paper. It is a collaboration between the Commonwealth and Queensland, Western Australia and Northern Territory Departments of Agriculture and Animal Health Australia. Current projects relevant to NT producers include:

Post-mortem sample collection kits

- All pastoral properties in the NT are being provided with a post-mortem sample collection kit during the annual property visits undertaken by the Livestock Biosecurity team. This kit can be used to collect samples for laboratory diagnosis in the event that livestock get sick or die.
- 80 kits have so far been distributed to pastoral properties in addition to the vets across the NT
- if you have not yet received a kit for your pastoral property, contact your regional Livestock Biosecurity Officer.

Subsidies for disease investigation

- subsidies of up to \$2,000 are available for disease investigations in cattle conducted by private vets until June 2019
- for disease investigations in horses and other species, subsidies of up to \$250 are available
- remember that \$300 is available for cattle showing nervous signs where a post-mortem is performed and the brain collected for “Mad Cow” exclusion testing
- contact your vet or regional Livestock Biosecurity Officer for more information.

Significant Disease Investigation (SDI) vet network

- the SDI vet network is a network of private veterinary practices, veterinary laboratories and government veterinarians who work in northern Australia.
- the network aims to increase the number of investigations, as well as improve sampling and reporting outcomes of SDIs in cattle conducted across the north to benefit producers.
- the network offers vets access to subsidies to undertake eligible SDIs, post-mortem kits, case assistance and professional development and networking opportunities.
- the network was launched in February 2018 with the first NABS SDI Masterclass held in Townsville on 23-24 February 2018. The workshop focused on priority animal diseases for northern Australia and investigations of respiratory disease, vesicular disease and skin diseases and was attended by 35 representatives from across private veterinary clinics, veterinary laboratories and government-based animal health surveillance streams in northern Australia.
- a second NABS Masterclass was held in Alice Springs on 22 March 2018 focusing on reproductive disease and calf loss investigations.



Figure 19. Map of distributed NABS post mortem sample collection kits (May 2018)



Figure 20. Vets at the NABS SDI Masterclass held in Townsville in 23-24 Feb 2018. L to R Front Row: Lee Taylor, Peter Trembath, Jonathon Lee, Nina Kung, Beth Cookson, Lorna Melville, Sue Fitzpatrick, Bill Tranter, Max Woods, Jack Daniels L to R Behind: Ian Braithwaite, Dave Forshaw, Kevin Bell, Peter Lynch, Justin Little, Derek Lunau, Rachael O'Brien, Regan Lynch, Libby Harriman, Lisa Stevenson, Trevor Smith, Graham Mackereth, Ryan Cockrem, Ed Butterworth, Hamish Brett, Tristan Jubb, Ian Langstaff, Peter Letchford, Zane Squarci, Dave Morrell, Brendan Brieffies, Toby Wass

Moving horses & livestock below the tick line

Under the Livestock Act, all horses and livestock are required to be treated for cattle tick under the supervision of a Livestock Biosecurity Officer BEFORE any movement commences.

You must give at least three (3) days notice (72 hours) and you must then move the horse no more than two (2) days after the treatment. The cattle tick line is located at Dunmarra. These conditions apply to all stock including cattle, buffaloes, horses, sheep, goats and camels. The reason for this regulation is to prevent the spread of cattle ticks. For livestock moving out of the Parkhurst Zone, the Parkhurst cattle tick line is located at Pine Creek. These conditions apply to all stock including cattle, buffaloes, sheep, goats and camels except horses and donkeys which must be treated before moving over the cattle tick line at Dunmarra or the border to WA or Qld.

Animal Biosecurity Services	WEEKDAYS (no GST) - FEES	WEEKEND & PUBLIC HOLIDAYS - FEES
Cattle tick inspection and supervision of treatment *	\$46.00 set visit fee + \$1.15 per head	\$103.00 set visit fee + \$1.15 per head
Weekend Horse tick inspection & treatment (No Fee for weekday)	N/A	\$149.00 set visit fee + \$1.15 per head
Supply Health Certificate for interstate livestock movement	\$33.00 per certificate	\$66.00 per certificate
Supply Property of Origin Health Declaration	\$33.00 per certificate	\$66.00 per certificate
Investigations to follow up breaches of the Livestock Act	\$34.00 per half hour	N/A

* if a tick inspection is for interstate movement a health certificate charge of \$33.00 will also be added

Note: Payment by Credit Card is required at time of service.

Why are there no charges for horses during the week?

Horses are a secondary host and low risk species for cattle tick. Inspection and treatment for cattle tick is undertaken to protect the cattle industry. Horses are moved frequently within the Territory for work and events and will still be required to undergo inspection and treatments to meet movement requirements. Fees will only be charged for inspection and treatment of horses on weekends and public holidays.

What can you do to help prevent the spread of cattle tick?

- follow correct transport practices when moving animals on and off your property
- contact your local Livestock Biosecurity Officer for animal inspections or supervised treatments.
- 3 days (72 hours) notice is required for all horse sprays and livestock dipping.

Bookings are made by contacting the Livestock Biosecurity Officer in your Region:

Darwin		Katherine	
Regional Livestock Biosecurity Officer	08 8999 2034	Regional Livestock Biosecurity Officer	08 8973 9767
Livestock Biosecurity Officer	08 8999 2030	Livestock Biosecurity Officer	08 8973 9765
Tennant Creek		Alice Springs	
Principal Livestock Biosecurity Officer	08 8962 4458	Regional Livestock Biosecurity Officer	08 8951 8125
Livestock Biosecurity Officer	08 8962 4492		

In brief: BOM NT survey; How did we do this wet season?

Jude Scott, BOM NT Media and Communications Manager

Although the wet season feels like a **long** time ago, please cast your minds back to help us get a better understanding of how you used BOM's services. We'll use the results of the survey to inform how we prepare for the next wet season, and identify what we can do to help you make well-informed decisions around weather impacts.

Please take 5-10 minutes to fill out our survey – we really value your opinions and feedback, the more responses we can get the better!

<https://e.bom.gov.au/survey.php?sid=21401&name=bom-nt-customer-satisfaction-survey--201718-wet-season>

Start BOM survey now!



Australian Government
Bureau of Meteorology

CALENDAR OF EVENTS



2/07/2018
18/08/2018

[Food Futures \(Darwin\)](#)

[2018 Melon conference \(Townsville\)](#)

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Can't find what you are looking for? Drop us an email and we will help you out.

Subscribe to our newsletters, Top Paddock, Katherine Rural Review, and Animal Health eNews to catch up on what we are doing, subscribe online here:

dpiir.nt.gov.au/primary-industry/primary-industry-publications/regional-newsletters

Our YouTube channel has a selection of "how to" videos on practical topics such as stock handling, grafting mangoes and date pollination. There are technical videos looking at measuring nitrous oxide emissions through to research updates.



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