

Top Paddock

DEPARTMENT OF PRIMARY INDUSTRY AND RESOURCES



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Message from the editor

The last Top Paddock for the year has such a spread of stories, I love it when we get to cover a broad range of industries like this.

Christmas closures

Berrimah Farm and Coastal Plains Research Farm will remain open over the Christmas- New Year period barring public holidays. Katherine Research Station will be closed from Friday 20 December 2019, reopening Monday 6 January 2020.

For emergencies during this period call animal biosecurity/ stock movements: 0467 740 233; or for other emergencies: 0427 600 388.

In early 2020 the Darwin-based Plant Industries and Livestock Industries staff will be moving buildings. We will still be located at Berrimah Farm, but if you are visiting it might be wise to call ahead and check where we are located.

Best wishes for Christmas and the New Year to you all, stay safe and we will see you in 2020!

Cheers

Chelsea Moore

Editor

Biosecurity alert: African swine fever

African swine fever (ASF) is geographically closer to the Northern Territory (NT) than anywhere else in Australia, following the recent confirmation in Timor-Leste. However, Australia remains free from ASF and the disease must be kept out.

The spread of ASF has been linked to domestic and feral pigs consuming swill (meat products, or products that have come into contact with meat that is infected with the ASF virus). It can also be transmitted by exposure to contaminated items such as equipment, vehicles, clothing and footwear.

ASF is a contagious disease of pigs and does not affect human health. The virus survives under most environmental conditions and is resistant to most disinfectants. It is not inactivated by freezing or heat less than 100 degrees Celsius.

The greatest risk of introduction of the disease is people illegally bringing pork or pork products into Australia from overseas and feeding those products to pigs.

The Department of Primary Industry and Resources (DPIR) has been working to raise awareness of the disease ensuring everyone understands that biosecurity is their responsibility.

With the confirmation of the disease in Timor-Leste, DPIR has commenced a coordinated preparedness approach to ensure all Territorians understand that they must not bring high-risk items into Australia and to report any sick pigs immediately to the department.

Territorians are urged to do their part. Biosecurity in the NT is everyone's business. You can help prevent an outbreak of ASF in Australia by:

- Paying particular attention to biosecurity requirements when visiting or returning to Australia, especially after visiting countries where ASF may be present. Before you travel, [check what can and cannot be brought into Australia](#).
- Never feeding pigs food or food scraps containing animal matter such as meat, meat products and eggs. This includes swill (food scraps) that is contaminated by animal matter. Only feed pigs commercially available feed, and always disposing of food waste properly so pigs can't eat them. The [National Farm Biosecurity Manual for Pork Production](#) contains information and specific procedures for all pig farmers to follow to help reduce the risk of disease entering a property, spreading through livestock and/or being passed to surrounding animals.
- Considering where your goods are coming from when buying online and whether they will meet our biosecurity conditions when they arrive at Australia's international mail facility. Before you make your purchase, [check what can and cannot be mailed to Australia](#).
- Registering for property identification codes (PICs). In the NT, it is a legal requirement for all owners of livestock, including pigs and chickens, to register their property with a PIC. [PIC registrations](#) are free and are crucial to managing responses to disease outbreaks and alerting property owners of a potential disease threat in the area.
- Familiarising yourself with the clinical signs of ASF, especially those Vets who treat pigs and other cloven hoofed livestock such as cattle, buffalo, sheep, goats, deer and camels. ASF is a reportable disease. Veterinarians must notify the [chief veterinary officer](#) in their state or territory if they suspect or know an animal has a notifiable disease.

DPIR has also been distributing information to registered vets within the NT, providing assistance to Timor-Leste and liaising with stakeholders and counterparts in the NT, Queensland, Western Australia, the Northern Australia Quarantine Strategy, the National Biosecurity Communication and Engagement Network and Darwin International Airport.

Surveillance, monitoring and additional activities are ongoing and DPIR will continue to work with the Australian Government Department of Agriculture to protect Australia's borders.

The NT Government is also asking pig owners and pig hunters to remain vigilant for ASF as this serious disease continues to spread through neighbouring regions.

If you're hunting and you observe a sick or deceased pig, please contact us. **Do not** come into contact with or move any pigs that are sick or found deceased.

For more information

Emergency Animal Disease Hotline:
1800 675 888

Visit the NT.GOV.AU [webpage on African Swine Fever](#)

Tips on growing cotton in Katherine



Figure 1. Ian Biggs and Nick Hartley inspect the irrigated cotton at Katherine Research Station.

DPIR pastoral agronomists Ian Biggs and Nick Hartley have been trialling rain-fed and irrigated cotton at the Katherine Research Station. They explain the project and some of their top tips in two new videos on the department's YouTube channel.

“The department has trialled dry season cotton at Katherine in the past, and it was affecting the quality of the cotton, because we were getting boll fill in the cooler periods of the growing time. This research is looking at wet season cotton for improved quality. We are testing some agricultural simulation models and measuring the yields from a rain-fed vs an irrigated system”.

DPIR has released the two videos to provide insight into growing the crop in the Katherine region and the trial itself. The [DPIR YouTube channel](#) has a range of short 5-minute videos on practical topics, including the growing cotton in Katherine region video.

For more information

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Visit the [NTG webpage on cotton](#)

Northern Territory ginger is set to shake-up the Australian industry



Figure 2. Fresh ginger, could it be a new crop for the Northern Territory?

DPIR recently established a co-innovation program with growers to support the development of a local ginger industry. A clean seed nursery and tissue culture protocol were established to supply commercial field trials with high quality planting material of Queensland gold and canton varieties. Results are very promising, particularly for the production of clean seed material. We intend to add value to the Australian Ginger Industry through the supply of clean planting material and counter-seasonal supply to displace imports.

The full article is published here on [LinkedIn](#).

Easing of restrictions for the control of citrus canker

The declared restricted area for the control of citrus canker disease has been removed from properties in Cossack, Katherine. The restricted area was established in June 2018 after a plant with the citrus canker disease was found in Cossack. The restricted area affected 20 properties which were within 600 metres of a plant infected with citrus canker.

Chief Plant Health Officer, Dr Anne Walters, said she was pleased with the update and thanked the community of Cossack for their support. "The restricted area in Katherine was cleared of all citrus canker host plants in late 2018 and there has been no evidence of citrus canker disease or any regrowth in the area," she said. "A designated minimum of six months without citrus canker host plants, known as the host free period, and no record of citrus canker disease during regrowth surveillance activities, has allowed for the restricted area to be removed."

Two control areas for the control of citrus canker remain in place around the greater Darwin and Katherine areas, and 12 restricted areas remain in the greater Darwin area. Dr Walters said that to ensure the disease was not persisting in the environment, citrus canker host plants cannot be taken into or grown in the remaining restricted areas and citrus produce still cannot be moved out of the control areas without a permit.

“These changes are great news for residents in Katherine as it allows residents in the former restricted area to cultivate and plant citrus plants again. “Citrus plants may be purchased from within the Katherine Control Area or areas free from citrus canker for planting within the former Katherine Restricted Area. Plants may not be purchased or moved from the Darwin Control Area as quarantine movement restrictions are still in place.

“The restriction on moving citrus fruit and juice from the control areas into a restricted area was also lifted today. This allows citrus growers within the larger control areas to sell their citrus fruit and juice to residents in restricted areas if the produce is for human consumption,” Dr Walters said. “The support and cooperation of growers in complying with these restrictions to date is appreciated and we support them in being able to start supplying locally grown citrus fruit and juice again in the restricted areas.”

The movement and cultivation restrictions are in place to help eradicate citrus canker from the Territory and allow Australia to claim freedom from this serious plant disease.

For more information

Citrus Canker hotline: 0436 643 470

Visit the NTG [webpage on citrus canker](#)

Study to spice up northern Australia



Figure 3. Fennel is one of several spices to be trialled at Coastal Plains Research Farm and Katherine Research Station as part of the new CRC for Northern Australia spice project.

Northern Australia is poised to create Australia’s spice trail with plans to grow a new condiment industry part of a new Cooperative Research Centre for Developing Northern Australia (CRCNA) project, headed by

Dr Surya Bhattarai from Central Queensland University (CQU). The \$1.2 million spice cropping project will see five crops taken from small to large-scale production within 3 years.

The project team spans seed and crop experts from agronomists from DPIR, Agriventis Technologies, irrigation and agronomist specialists from the Burdekin-Bowen Integrated Floodplain Management Advisory Committee, economic development experts from the Rockhampton Regional Council, and the Western Australian Department of Primary Industries and Regional Development as well as six growers from across Queensland and the NT.

The team will initially run small trials of cumin, fennel, kalonji, caraway and black sesame crops, after earlier glasshouse trials showed they had strong potential for inclusion in broadacre crop rotations. The small trials will be across several different locations and used to assess the suitability of crops for wide-scale commercial production in northern Australia.

In the NT, trials will be located at Katherine Research Station, and Coastal Plains Research Station. Rain-fed black sesame and fennel trials are scheduled for planting at the end of 2019, with a field walk planned for April 2020.

Commercial trials are due to start in the project's third and final year, by which time there will be a comprehensive manual for producers detailing which crops to grow, the best areas to grow them and an outline of the market and supply chain opportunities.

CRCNA CEO Jed Matz said the project would provide the foundation for a new, high-value industry with the potential to transform northern agribusinesses. "This project will build the supply chain links needed to establish a new and viable industry for northern Australia and create new income streams for producers."

Agriventis Technologies CEO Lewis Hunter said the long-term goal of establishing a base level of spice crop production would be achieved through extensive grower engagement focusing on extension and adoption strategies. "We hope to build support among growers for spice production and provide them with the evidence and best management strategies they need to profitably include condiments in their farming systems."

A high-value broadacre condiment industry in northern Australia could replace imports and generate exports to Asia and the Middle East and see northern producers secure their share of the growing global spice trade – estimated to be worth around \$12 billion annually.

For more information

CRCNA project media enquiries,
Carla Keith, 0499 330 051

Visit the [CRC for NA project page](#)

Michael Thomson, CQU Communications &
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TropAg 2019 reflections

Plant Industries staff, Mila Bristow and Cameron McConchie attended TropAg 2019 held in Brisbane on 11-13 November. Here are some of their thoughts about the conference, the research and technology presented and reflections on where agricultural science is heading. TropAg 2019 is an international agricultural meeting held in Brisbane with over 700 delegates from 50 countries.

The conference had programs under the broad headings of field crops, horticulture, livestock, nutrition and food, and ag-futures.

“The program was packed full of interesting talks, so for me the biggest dilemma was which session to attend. It was an excellent opportunity for the Queensland agricultural industries to promote their science and their vision for the future. It was also a great chance to see what is happening in this area.”

- Cameron McConchie.

The highlights

The Queensland Alliance for Agriculture and Food Innovation (QAAFI) team are increasing their emphasis on Australian flora for food products. An exciting example of this was the international collaboration developed with Indigenous communities around rice products. Wild rice has been part of the diets of Australia's Indigenous population for thousands of years, it is distantly related to aromatic rice and has been attracting increasing interest as a gourmet/ niche food product. Visit the CRC for Developing North Australia's [CRC NA website](#) for news on this project.

There were discussions around developments in pest and disease management, including NT DPIR's work on banana *Fusarium* Wilt, Tropical Race 4. For a quick run-down on this work visit the [NT Government banana plant protection webpage](#).

During the conference the bush fires were raging up and down the east coast and the presentations on climate change attracted a large audience. One of the key sessions led by the University of Southern Queensland's (USQ) climate science team explained the detailed science that informs our understanding of today's climate. This offered insight into multi-decadal drought patterns and the impacts on farming in the north. Some very practical outcomes were presented including the [Northern Australia Climate Program](#), which our Territory producers have been involved in as we bring BOM to the Bush and the Climate Mates program (see this [USQ article](#) for more information).

Particularly interesting were the talks about gene editing to manipulate crop performance and accelerate plant breeding programs. This is a complicated topic, but there is a good explanation about it in this [QAAFI article](#). This technology may be used to develop methods that address some of the threats for crop production in the tropics. Possible applications include non-browning apples, potatoes and mushrooms, soybeans with higher levels of oleic acid to improve the fatty acid profile. To read more information about this technology read this [Agrifutures article](#).

The next conference is scheduled for November 2021.

FutureBeef: a treasure-trove of resources for north Australian beef producers



Figure 4. Looking for information on your heifers? FutureBeef might be what you are looking for.

FutureBeef provides the northern beef industry with information and tools to assist with making on-property changes that improve business performance.

Our strength comes from the coordinated and collaborative approach to the delivery of online information, promotion and industry engagement through government agricultural departments in Queensland, the Northern Territory and Western Australia working with Meat and Livestock Australia.

How do you like your information?

- FutureBeef has social media accounts on Facebook and Twitter
- A free monthly online newsletter delivered to your inbox
- 1,000 pages of high quality online content plus a comprehensive industry events calendar

Examples of NT projects featured on FutureBeef include:

- The Self Herding trial at Kidman Springs

<https://futurebeef.com.au/projects/self-herding-kidman-springs/>

- The Paddock Power project looking at profitable and sustainable intensification

<https://futurebeef.com.au/projects/paddockpower/>

- The selected Brahman fertility project

<https://futurebeef.com.au/projects/selected-brahman-project/>

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<https://www.youtube.com/user/FutureBeefAu>



New project set to revive mango best practice



Figure 5. Mangoes are the focus of the new collaborative HIA project.

The mango industry is set to benefit from a new mango best practice project as a suite of organisations and state departments join efforts to consolidate mango growing knowledge. The project, funded by Horticulture Innovation Australia, is compiling a wealth of information from past research and making it accessible through a series of workshops, publications and an updated website hosted by Australian Mangoes.

DPIR has partnered with the Australian Mango Industry Association (AMIA), Queensland Department of Agriculture and Fisheries, Western Australia Department of Primary Industries and Regional Development, Central Queensland University and the NT Farmers Association to develop a best management practice resource for the Australian mango industry. It will build on previous research and extension to deliver a nationwide best practice resource, focused on improving grower profitability.

The three year project will cover several topics including:

- irrigation
- pest and diseases
- resin canal discolouration
- harvest forecasting

- harvest and post-harvest practices.

Research scientist Maddison Clonan is leading the DPIR component. “This is a great opportunity for us to collaborate across northern Australia. I think it will be really useful to consolidate this portion of mango research into a single online website for growers to access.”

Industry workshops and events will be held to present the content for each topic, both in Darwin and Katherine. The final content will be available electronically through the AMIA website and as a hard copy after the project. Whilst the project is developing, content will be published through a range of platforms including YouTube, podcasts, and fact sheets.

For more information

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Visit the NTG [webpage on mangoes](#)

Visit the [Australian Mangoes website](#)

Pasture species and fire



Figure 6. Fire scorched ground with grassy regrowth. All pasture species in the Top End of the Northern Territory need to be capable of surviving burning. Fires may be deliberately lit for several reasons including for control of regrowth or woody weeds, or be a random wildfire lit by persons known or unknown, or lightning.

Native pasture species have evolved under a natural burning regime. At the end of the wet season the perennial native grasses store nutrients and energy in their roots. When they are burnt there is a low loss of these resources. If the soil is still wet when burnt, there may be a small amount of regrowth, known as “green pick”. Some introduced pasture species; particularly the perennial grasses, have the same survival mechanism as the native perennial grasses, storing nutrients and energy in their roots.

For both native and perennial grasses, it is best to only graze lightly after burning to lower the stress on the individual plants and help them survive the dry season.

Introduced legumes such as Leucaena and Shrubby stylo will produce fresh green shoots at ground level following burning. As with the grasses it is best to graze this regrowth lightly. With other introduced

legumes such as Amiga, Verano and Wynn cassia the plants are killed by the fire, but they can re-establish from soil seed banks during the next wet season. These legumes can have massive recruitment events following a fire because the heat of the fire breaks down their dormant hard seed.

For more information

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New Biocrust project - Boosting natural regeneration of the nitrogen capital in grazing lands



Figure 7. Biocrusts can consist of lichens, mosses (above), liverworts and cyanobacteria (blue-green algae).

The University of Queensland (UQ) has been funded by Meat and Livestock Australia (MLA) to research the impacts of fire and grazing on the function of *biocrusts*. The UQ researchers are collaborating with DPIR at the Kidman Springs fire experiment and with the Queensland Department of Agriculture and Fisheries at the Wambiana grazing trial in north Queensland.

What are biocrusts?

Biocrusts are the 'living skin' on the surface of the soil. They are composed of lots of different tiny organisms including cyanobacteria, fungi, green algae, bacteria, lichens, liverworts and mosses. They grow when it's wet and become inactive when it's dry, just like plants.

Why do we care about biocrusts?

They stabilise the soil surface - the filaments of the different organisms bind together the soil surface and prevent erosion from wind and water.

They photosynthesize and fix carbon - the algae and cyanobacteria are green and photosynthesize just like plants. The carbon is incorporated into the soil and enhances soil carbon.

They fix nitrogen! Most cyanobacteria fix nitrogen out of the air just like legumes do! The nitrogen is in a form available to plants with excess stored in the outer slime (EPS). When it rains much of the stored plant-available nitrogen is washed from the EPS into the surrounding soil. Additionally, when biocrusts dry out and a proportion will break down (particularly during the early wet season rains) at which time the nutrient-rich biocrust is incorporated into the soil as organic matter. The amount of nitrogen biocrusts fix every year is similar to the amount of nitrogen fixed by native legumes in our grassy tropical savannas.

Soil fertility is a major limitation to pasture growth in tropical savannas, but it doesn't pay to add fertilisers because the extensive scale is prohibitive. We are testing if we can manage grazing and fire to maximise the natural carbon and nitrogen inputs by biocrusts into soils and enhance soil fertility in tropical savannas.

Where are biocrusts?

They are in the top centimetre of the soil, usually covering the 'bare' spaces between plants. Biocrusts are found all over the world from freezing Iceland to hot deserts and wet-dry savannas, but different regions have different dominant organisms in the biocrusts, depending on the rainfall and temperature. In tropical savannas biocrusts are dominated by cyanobacteria.

What do they look like?



Figure 8. Dark staining on the soil surface of biological crusts on the black soil in the dry season at Kidman Springs.

In northern Australia they often appear as dark staining on the soil surface in the dry season (Figure 7). They can form dark green slimy films during the wet season (Figure 8).

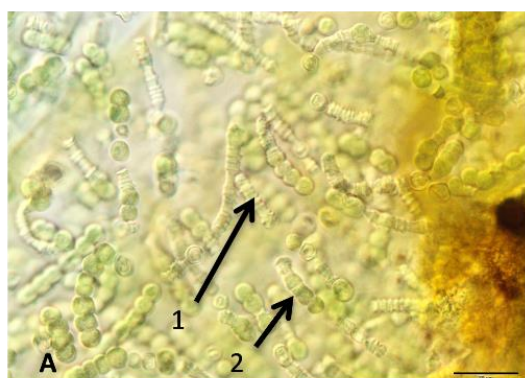




Figure 9. Cyanobacteria and associated crusts in dry and recovery stages: (A) Cyanobacterium *Nostoc commune* in a transition state between dry stage (arrows 1) and rehydration (arrow 2), embedded in EPS (polysaccharide slime) (scale bar 20 μm); (B) *Nostoc commune* encapsulated in EPS (arrow 1) and embedded in ECM (extra-cellular (slime) matrix, arrow 2), (scale bar 20 μm); (C) *Nostoc* in gelatinous mass EPS production state overflowing new *Scytonema biocrust*; (D) following EPS production, consolidation of ECM occurred with defined biocrust formation; (E) Newly developed crust (still saturated from rain) that incorporated *Symplocastrum*, *Scytonema*, *Symploca*, *Nostoc* and liverworts (*Riccia*); (F) Dried and cracked *Symploca* dominated crust in situ in early stages of disintegration following the first rains early in the wet season (Merluna, Cape York, 2010) Images Wendy Williams: <https://www.biogeosciences.net/15/2149/2018/>

But wait, aren't soil crusts a bad thing?

There are two types of soil crusts. Living biocrusts are distinct from dead physical soil crusts that form on degraded soils. Physical soil crusts can inhibit water infiltration and plant growth. Living biocrusts enhance soil moisture and plant growth.

What effect does fire and grazing have on biocrusts?

Fire can enhance biocrusts by removing litter, trees and shrubs that would otherwise compete as ground cover, yet you need the right amount of fire, not too much, not too little. Biocrusts in Australia's tropical savannas, like our native vegetation, are well adapted to fire because they evolved with fire. Preliminary sampling at our Kidman Springs Fire Experiment found the highest soil plant-available nitrogen (fixed by biocrusts), was in four yearly late dry season burnt sites, more than unburnt or two yearly late burnt sites.

Grazing can also potentially open up interspaces for biocrusts by reducing plant cover. Nevertheless, the trampling by hooved animals is not something Australian ecosystems have evolved with, so our biocrusts are quite susceptible to heavy trampling. The effects of moderate vs. heavy grazing on biocrusts will be examined at the Wambiana grazing trial near Charters Towers.

If trampling is bad for biocrusts how can we manage grazing to benefit biocrusts?

Biocrusts grow during the wet season, just like plants. During the dry season they dehydrate and become dormant. The carbon and nitrogen they fix is broken down and recycled by other critters in the biocrust, and then becomes incorporated into the soil and available to plants. We suspect that spelling over the wet season and grazing during the dry season will benefit not only palatable plants, but also biocrusts, allowing them to maximise their growth and nitrogen fixation. As pruning a shrub or tree in a garden encourages growth, moderate disturbance of biocrusts can promote growth. It is also possible that some intermediate level of grazing will enhance growth and productivity of biocrusts in the savanna.

Biocrust facts

- Biocrusts cover more than 12 per cent of the Earth's land surfaces and fix seven per cent terrestrial carbon and 45 per cent plant-available nitrogen.
- The growth of savanna grasses and forbs that don't fix nitrogen is higher in the presence of biocrusts, probably because they benefit from the extra nitrogen fixed by the biocrusts.
- Cattle have been observed to lick biocrusts! (anecdote from Bruce Alchin)
- There are viruses, bacteria and very small insects that make their living just off biocrusts. Samples of biocrusts from Kidman Springs examined under a microscope had 'herds' of tiny collembola (springtails) selectively grazing the cyanobacteria in the biocrusts, 'like cows in a paddock walking around from here to there searching for the legumes'. These are known to increase N-fixation by cyanobacteria!
- Biocrusts can be useful in land reclamation and rehabilitation. For example native seed germination and survival is higher when you coat them in cyanobacteria.
- Biocrusts reduce the germination of weeds.
- Biocrusts are often the dominant ground cover in deserts.
- Lichens and mosses dominate biocrusts in cold deserts (southern Australia), while cyanobacteria and liverworts dominate biocrusts in warmer environments (northern Australia).

For more information contact Robyn Cowley, Livestock Industry Development.

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Phone 0419 829 493

Territory growers and researchers shine at the TNRM awards night



Figure 10. A great night was had by all at the 2019 TNRM awards. Martina Matzner from Acacia Hills Farm and Josh Clementson from Nutrano, with some of the members of the DPIR mango team Alan Niscioli, Dallas Anson, Mila Bristow, Jo Tilbrook and Maddison Clonan.

The 2019 Territory Natural Resource Management (TNRM) awards night was recently held at the Darwin Convention Centre. These awards recognise excellence in resource management across a range of categories including the Farmers and Fishers Sustainability Award, and the Research in Natural Resource Management Award.

“It was a great night out and it’s nice to see recognition for all of the growers, researchers, and groups who are making an effort to champion sustainability, best management and biosecurity practices”. Mila Bristow, Director Plant Industry Development.

Congratulations to all of the nominated parties, for all of their effort and dedication. A special mention for producers Eva Valley Meats, winners of the Farmers and Fishers Sustainability award; plus runners up The Desert Fruit Company, Tamara Co-operative and Coodarie Station.

Congratulations also to our DPIR researchers from the More Profit from Nitrogen team and Samantha Nowland from aquaculture who were also nominated for awards. It is wonderful to see agriculture and fisheries represented on the night.

For a full listing of awards, nominations and winners head on over to the [TNRM webpage](#).

Mango leaf litter and prunings: a large and hidden nitrogen input



Figure 11. Testing nitrogen efficiency in mango trees with automated greenhouse gas chambers

Joanne Tilbrook, Alan Niscioli, Dallas Anson, Danilo Guinto, Heshan Jayasekara, David Rowlings*, Raj Pandeya* and Tony Asis

* Queensland University of Technology, Brisbane, QLD 4000

In mango orchards, falling leaves, flowers, branches, fruit and end of season prunings are often left on the orchard floor and inter-rows, all discretely adding to the nitrogen rich biomass or “litterfall”. However, the quantity and nutrient content of this material has not previously been documented, nor do mango growers take it into account when applying nitrogen (N) to their trees. As part of a project on enhancing nitrogen use

efficiency in horticultural systems, we examined the amount of litterfall from two commercial mango orchards in the NT and measured the nitrogen content within.

The majority of litterfall occurs from flowering through to fruit maturity, approximately 100 days. Recent work has shown that most leaf litter decomposes every wet season in the Darwin and Katherine regions, so it is cycling annually.

We collected the litterfall in Calypso® and Kensington Pride (KP) orchards for a year, trapping the plant material in trays and tarpaulins. The material was separated into leaves, flowers, panicles, fruit and branches before being analysed for N content. The dry weights of litterfall from both mango varieties were around 4 tons/ha (Figure 1) with Calypso® material containing 18.8kg N/ha and Kensington Pride 22.2 kg N/ha (Figure 2).

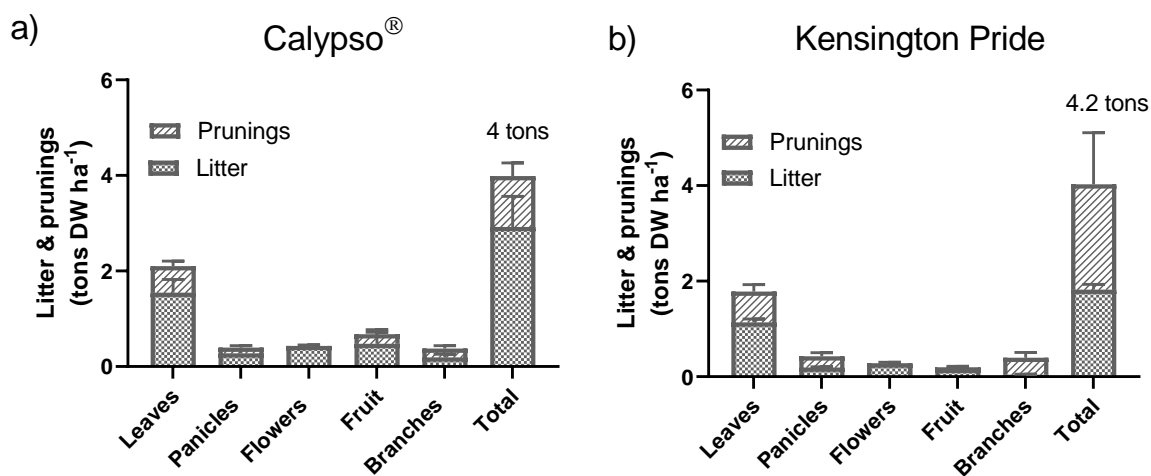


Figure 12. Differences were noted in the amount of litterfall between varieties and sites over a year, however the total amount was similar between orchards, with Calypso (a) generating 4 tons ha⁻¹ and Kensington Pride 4.2 tons ha⁻¹ (b).

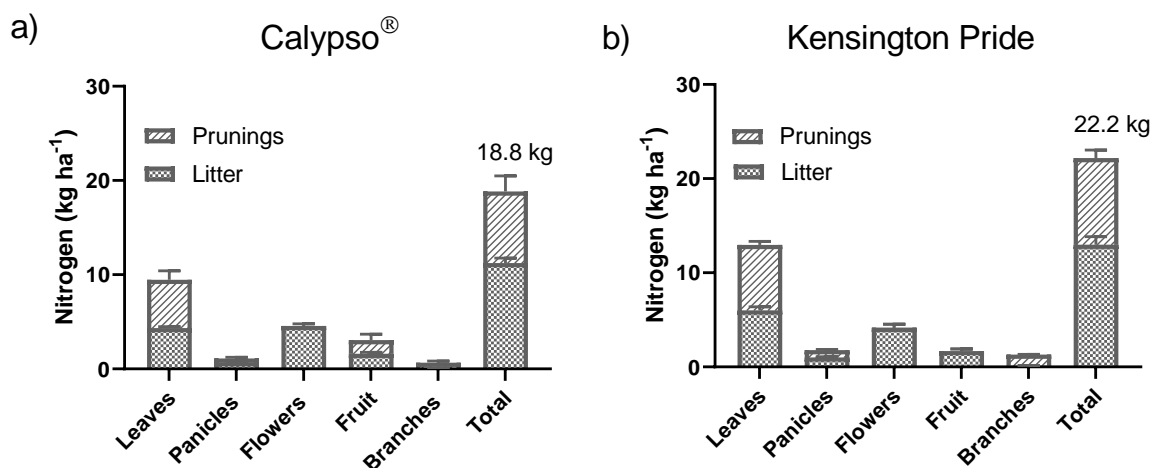


Figure 13. Nutrient analysis of the litterfall shows that the Calypso® orchard contained 18.8 kg N ha⁻¹. The Kensington Pride litterfall had 22.2 kg N ha⁻¹.

To put this into perspective, if you apply a generic 12:2:13 fertiliser at the [Agrilink](#) recommended annual rate of one to two kilogram per tree, you will be applying 40-60kg per hectare of N. We know that this quantity

of N is too much when applied in local orchards, as it frequently results in postharvest 'stay green' skin and higher rates of fruit defects as mangoes ripen.

While the numbers will vary according to tree planting density and management, our research shows that the N inputs from mango litterfall is significant. In-situ N recycling should be included when calculating orchard N needs in NT commercial orchards.

This project is part of the More Profit from Nitrogen Program, supported through funding from the Australian Government Department of Agriculture as part of its Rural Research and Development for Profit program, the Northern Territory Government Department of Primary Industry and Resources, Queensland University of Technology's Institute for Future Environments and HortInnovation. In-kind support is also provided by the Australian Mango Industry Association Inc.

What did you do for National Agriculture Day this year?



Figure 14. DPIR Community Engagement Officer, Jo Scott talks to primary school students about biosecurity for National Agriculture Day.

The DPIR National Citrus Canker Eradication Program and Northern Territory Farmers Association teamed up to celebrate and encourage community support for our farmers on 21 November.

NT Farmers Workforce Planning Coordinator, Aisla Connolly, and DPIR Community Engagement Officer, Jo Scott, spent the day at Girraween Primary School teaching students about biosecurity threats to our agricultural and horticultural industries. The school has a wonderful school farm and with most students coming from rural properties, they showed great interest in the topic and asked many well-considered questions.

Students learned about biosecurity activities that are happening all the time to protect people, animals and plants from pests and diseases. They discussed citrus canker disease and how each of us can help eradicate

this disease from the NT. Students also enjoyed a game of fruit bingo – a fun way to build knowledge of which fruits are citrus.

Girraween Primary School plan to continue student learning in biosecurity with some independent activities in their school garden and are interested in a biosecurity-themed inquiry learning project next year.

The visit also marked an exciting milestone for community engagement, with delivery of biosecurity education to over 1,000 school students under the National Citrus Canker Eradication Program.

Biosecure HACCP program in plant nurseries



Figure 15. Northern Territory nursery plants

Is your nursery Biosecure HACCP certified? BioSecure Hazard Analysis Critical Control Point (HACCP) is an industry biosecurity program, funded by the NGIA levy, to assist grower assessments of pest, disease and weed risks. It also guides growers in the implementation of management strategies at critical control points.

Throughout 2019, the NT Government undertook a project to engage with and develop further awareness of the Biosecure HACCP program across production nurseries in northern Australia. This forms part of an increasing effort by the NT Government to collaborate with industry to enhance biosecurity efforts to protect NT industries from exotic pests and diseases, which can seriously affect productivity and the viability of businesses. The devastating effects of pests has been recently observed through the citrus canker and banana freckle eradication programs. Preventing future incursions will be critical for supporting the continued growth of existing industries and promoting the development of new enterprises in the NT.

Regular contact with the participating businesses (four local NT businesses participated for the full duration of the project) was an integral part of the project. This was made possible through a dedicated project officer appointed to help manage the project, and meet with businesses regularly.

As part of this project, an audit was carried out at the onset and completion of activities, gaining valuable insight into the perceptions of nursery businesses within the NT. The importance of gaining this pre- and post-project perception has been critical to guiding relevant discussions for businesses and focusing of key areas of concern.

Further to these audits and regular visits, a major component of the project was the delivery of a training program across northern Australia, delivered through Greenlife Australia (GIA). The project-based workshops explored integrated pest management, the availability of resources (through the farm management system website run by GIA), and practical skills associated with monitoring for a pest and weed species in the nursery. This training was held across the NT, Queensland and Western Australia.

The project has been successful in improving biosecurity awareness and surveillance in several production nurseries in northern Australia. While the project funding has now finished, the NT Government will continue to provide support for local businesses to continue to uptake and improve their biosecurity practices. This will assist with capacity building for businesses and their staff.

The NT Government would like to thank all participating nurseries for their time and efforts during this project, and look forward to seeing the biosecurity awareness expand further into the future.

For more information

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Plant Biosecurity Branch
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[BioSecure HACCP webpage](#)

Seasonal outlook

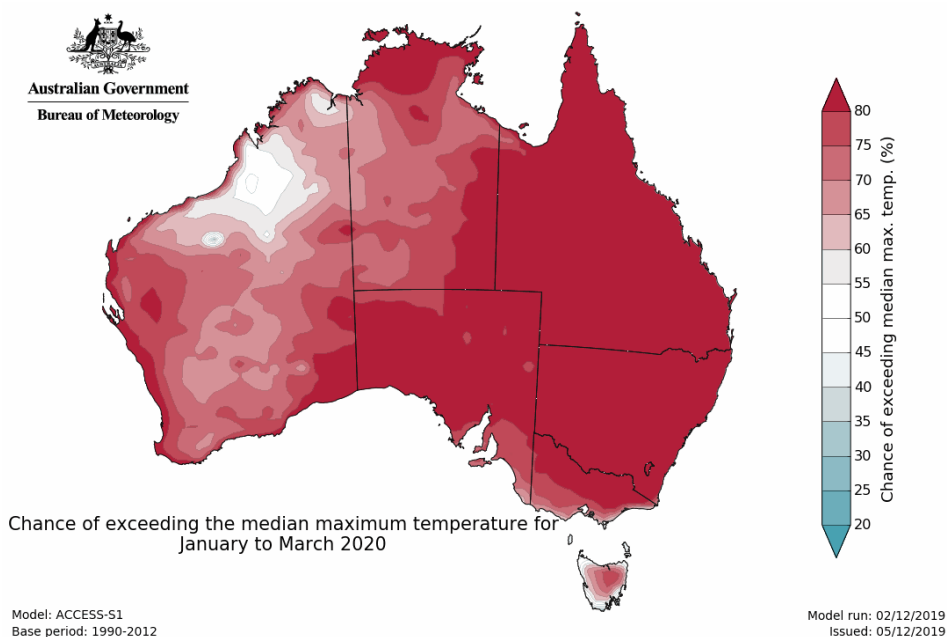


Figure 16. The BOM are predicting hotter than average temperatures for the January to March period.

The Bureau of Meteorology (BOM) produce a [weekly tropical note](#), as well as [three month climate predictions](#), both available on their website. Their predictions for the coming months include:

- January to March 2020 daytime temperatures are very likely to be above average across Australia.
- January to March 2020 nights very likely to be warmer than average apart from the southeast.
- Below average rain over northern Australia in December 2019. There is still no tropical trough south of the equator—this is usually well established by this time of the year and is a precursor to the monsoon. This suggests there is a high probability of a delayed monsoon onset for Australia in 2019–20.

- For the Top End, rainfall is predicted to return to average conditions from January to March.

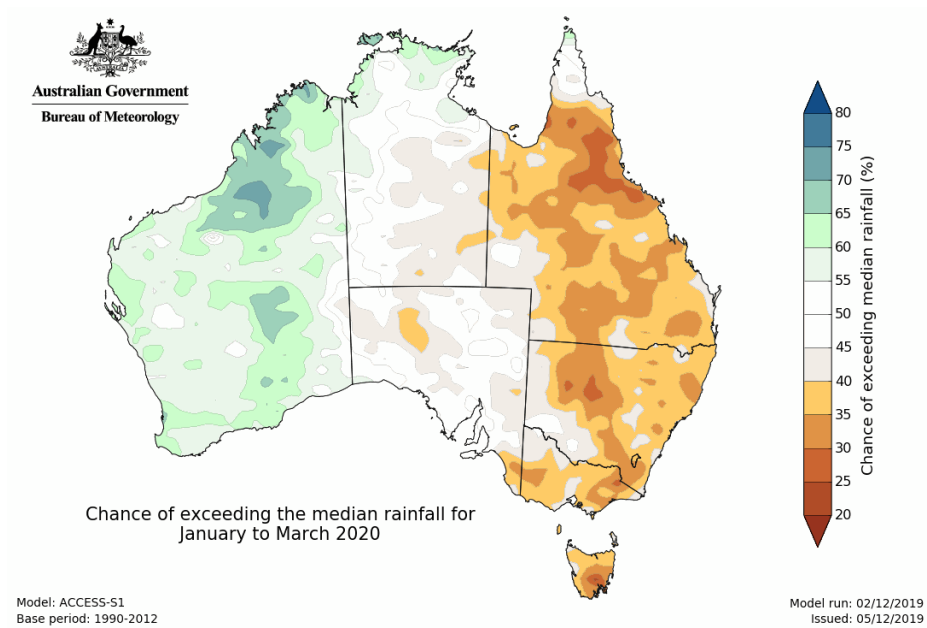


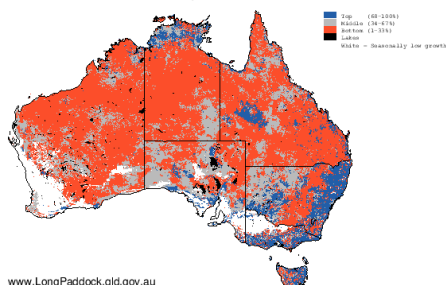
Figure 17. The BOM are predicting average rainfall for the Top End, for the January to March period.

You can watch their climate and water outlook on the [Bureau of Meteorology YouTube channel](#).

What does this mean?

Pastures

Most Likely Tercile for Pasture Growth
December 2019 to February 2020



The Long Paddock is a Queensland Government initiative, which maps the likely pasture growth across Australia based on climate predictions. The latest forecasted pasture growth from AussieGRASS suggests that between December 2019 and February 2020 there will be lower than average growth (bottom 33 per cent of all years) for most of the NT except for the Top End which will have average to above pasture growth. You can see their maps on the [Long Paddock webpage](#) and watch the videos explaining what they mean.

Water levels

Darwin Rural Groundwater Watch



Water level information is available from the [Darwin Rural Groundwater Watch webpage](#). The NT Government releases graphs of the water tables levels over time, updated at the end of each month. The majority of the NT's water supply (90 per cent) is from groundwater, which is recharged through rain during the wet season. Drier than average wet seasons can significantly impact water levels.

More information?

The Australian Bureau of Meteorology (BOM), CSIRO and Farm Link have published a series of information sheets on regional weather. They break down their explanations on rainfall, temperature, evaporation and changes over the past 30 years. You can read more in their [Top End regional weather and climate guide](#).

Pastoral market update

The pastoral market update lists livestock exports for the Northern Territory. It can be found on the [pastoral market newsletter page](#).

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Hort Connections 2020

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[Mar 30- Apr 1, Perth](#)

[Jun 15-17, Brisbane](#)

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