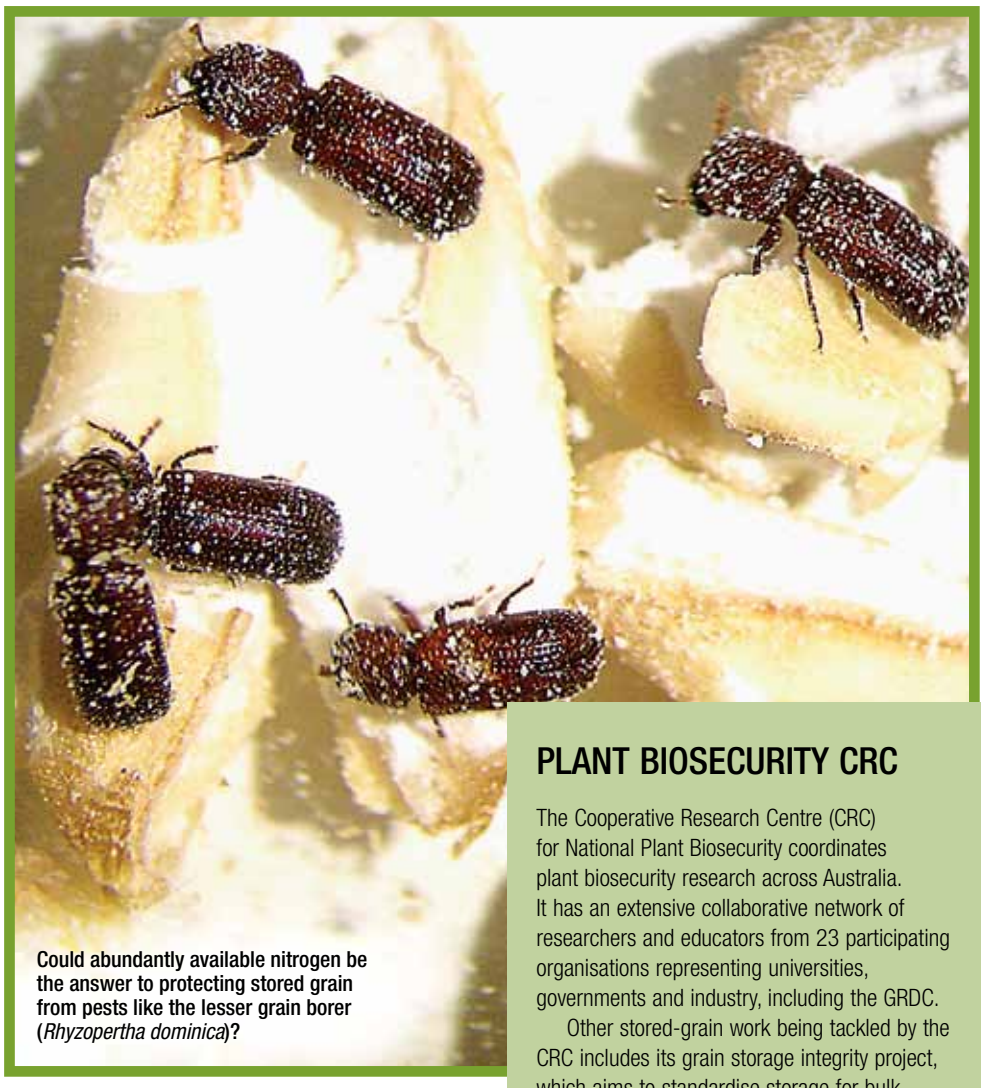
# Nitrogen explored as fumigant option

Research to develop phosphine alternatives is turning to nitrogen. Although at this stage nitrogen is not recommended as a fumigant for on-farm storage use

## NITROGEN BENEFITS

A nitrogen-based, controlled-atmosphere technology system for protecting and disinfesting grain has several potential advantages over other fumigants:

- nitrogen constitutes 78 per cent of 'air', thus air is a rich, free source of nitrogen;
- nitrogen is not toxic;
- use of the system would greatly reduce occupational health and safety and environmental risks;
- nitrogen provides a residue-free grain;
- nitrogen has no known resistance problems;
- nitrogen does not react with construction materials;
- there is no need for ventilation before grain can be marketed;



Could abundantly available nitrogen be the answer to protecting stored grain from pests like the lesser grain borer (*Rhyzopertha dominica*)?

BY REBECCA THYER

■ An inert gas that comprises 78 per cent of our atmosphere is being researched as an alternative fumigant for stored grains.

Nitrogen is the atmosphere's most dominant component, with oxygen (20.9 per cent), argon and carbon dioxide completing the mix. And if research by the Cooperative Research Centre for National Plant Biosecurity (Plant Biosecurity CRC) is successful, it could also become an important stored-grain fumigant, providing an alternative to phosphine.

Using pressure swinging adsorption (PSA) technology, the atmosphere within stored-grain facilities can be modified to remove everything but nitrogen, effectively fumigating the grain load.

As a fumigant, nitrogen could potentially offer many benefits, says Murdoch University's Associate Professor YongLin Ren, who is researching phosphine alternatives. "It is safe to use, environmentally friendly and its only operating cost is electricity. It also produces no residues, with the atmosphere returning to normal as soon as the PSA machine is turned off."

Previously with the (now closed) CSIRO Stored Grain Research Laboratory in Canberra, Associate Professor Ren has moved to Perth to take up the role of principal scientist with the Department of Agriculture and Food, Western Australia's (DAFWA) stored-grain research team.

However, through a Plant Biosecurity CRC initiative he has been seconded to Murdoch University for three years to help train the next generation of biosecurity scientists, while working on CRC stored-grain projects – one of which is phosphine alternatives.

Associate Professor Ren reiterates the work's importance: "If just one kernel of grain is damaged (by insects) Australia's grain export reputation is damaged."

He notes that following wheat market deregulation more growers are storing grain on-farm, making the need for stored-grain research essential. Bulk handlers and exporters also need viable fumigation alternatives. And although phosphine will remain an important fumigant, with research also being done to try to ensure its longevity, there is a need to explore options.

"Phosphine is very popular and very cheap, but there are issues with occupational health and safety (OH&S), residues and insect resistance, and it is a security-sensitive chemical."

International Maximum Residue Limits (MRL) allow for 0.1 milligrams of phosphine per kilogram of grain. However, many countries are reducing this, Professor Ren says. "Spain has reduced the limit to 0.01mg/kg, China to 0.05mg/kg and India to 0mg/kg. It is now very easy to monitor phosphine residues and Australia needs to be aware of this."

These MRL changes become even more important as phosphine resistance – which has been documented in eastern Australia – increases, Associate Professor Ren says. That is because as resistance builds, so do the chances of increased residues and greater MRL risks because more phosphine treatments are needed to eradicate harder-to-kill pests.

Last year saw an alternative to phosphine registered for use in grains – ProFume™ (sulfuryl fluoride). Although it does the

## PLANT BIOSECURITY CRC

The Cooperative Research Centre (CRC) for National Plant Biosecurity coordinates plant biosecurity research across Australia. It has an extensive collaborative network of researchers and educators from 23 participating organisations representing universities, governments and industry, including the GRDC.

Other stored-grain work being tackled by the CRC includes its grain storage integrity project, which aims to standardise storage for bulk handlers and growers.

Associate Professor YongLin Ren says the work would provide growers with a standard design to help them when purchasing on-farm storage. "It would outline what equipment should be attached, what re-circulation system should be used, what capacity it should be, and so on."

# Student tests surveillance sensitivity

Just how sensitive Australia's surveillance processes are for detecting emerging pathogens or pests is being researched by PhD student Nichole Hammond, supported by the Cooperative Research Centre for National Plant Biosecurity.

Existing surveillance systems, which focus on targeted surveillance for a specific pathogen or pest, only report on the status in a particular time period, effectively providing a 'snapshot', she says.

Instead, by using a statistical method called scenario tree modelling, Ms Hammond aims to model the surveillance process from infection to detection and establish how sensitive it is, if it can detect the pathogen or pest of interest, and if other data could complement existing systems.

She says it is essentially about being able to use existing data to support claims of area freedom: "It is about turning our negative surveillance results into something tangible that we can take to our trading partners."

If the research proves the surveillance process is effective, Australia could use annually generated information to report on the status of plant pathogens or pests of concern. This is important under the World Trade Organization's Agreement on the Application of Sanitary and Phytosanitary Measures, which states that countries can no longer restrict plant product imports for non-scientifically justifiable reasons.

Ms Hammond, who is based at the Department of Agriculture, Western Australia (DAFWA) and enrolled through Murdoch University, is using DAFWA's Karnal bunt surveillance data as a case study.

This includes 'active' annual surveillance data from bulk exporters, who send samples to DAFWA each year for testing and 'community' data – the general surveillance information collected by DAFWA in numerous ways, such as samples from growers and reports from agronomists.

Although Ms Hammond is still working on this community data, she says her research is showing high confidence in the existing surveillance system's ability to demonstrate WA's freedom from Karnal bunt.

– Rebecca Thyer

PHOTO: REBECCA THYER

Plant Biosecurity CRC PhD candidate Nichole Hammond.

job, Associate Professor Ren says that it has relatively low toxicity to insects at the egg stage and has raised environmental concerns. Sulfuryl fluoride is also a greenhouse gas – 4800 times the potency of carbon dioxide or equivalent – and stays in the atmosphere for 36 years.

Altogether, the need to research alternative fumigant options, such as nitrogen, is warranted Associate Professor Ren says.

He says the nitrogen project will focus on developing controlled-atmosphere technology to the 'ready for adoption' stage, where it could potentially function as a replacement for phosphine for use on-farm and by bulk handlers and exporters.

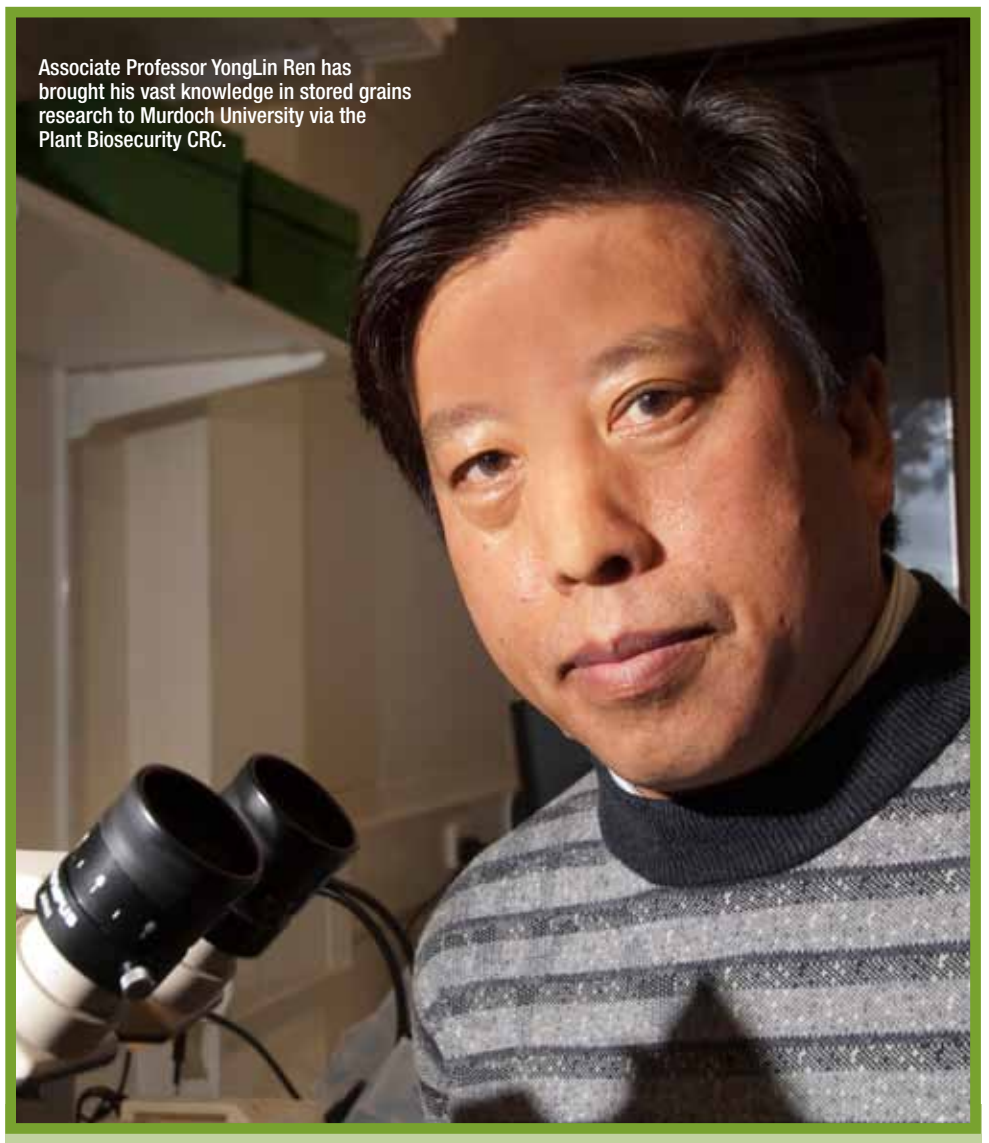
Nitrogen is already in use at many of Australia's bulk handlers, including CBH, ABB and GrainCorp. For example, Graincorp's Newcastle terminal has been using nitrogen to treat exported grains for some years, Associate Professor Ren says. "The running cost is not expensive – at about 25 cents per tonne of grain – and CBH and ABB are in the process of purchasing large-capacity PSA nitrogen generators for treating exported grain."

Professor Ren says.nitrogen's environmentally friendly attributes might allow nitrogen-treated grain to be marketed as 'green grain'. It could, for example, offer a solution for treating imported organic flour, he says.

During the next three years, Associate Professor Ren and his team expect to refine the technology to the point where it is ready to be adopted. However, he emphasises that phosphine will continue to be important for stored grains. He sees nitrogen as having the potential to become a more viable alternative and perhaps slowly, gradually its use will increase, depending on costs, technology and policies. □

More information: YongLin Ren, 08 9360 1397, y.ren@murdoch.edu.au

PHOTO: REBECCA THYER



Associate Professor YongLin Ren has brought his vast knowledge in stored grains research to Murdoch University via the Plant Biosecurity CRC.

## Early farm role for YongLin Ren

In his new role in Western Australia, Associate Professor YongLin Ren has been travelling across the state talking to growers about biosecurity and in particular the work he will lead on stored grain pests.

Although he has been a researcher for some decades now, he has had first-hand farming experience. Originally from China, Associate Professor Ren spent two years being 're-educated' during the country's Cultural Revolution, working as a farmer growing wheat, maize, cotton and sweet potato.

After he was allowed to return to his studies, he completed a bachelor degree at Henan Industrial University's Faculty of Grain and Oil Storage.

Employment at China's Ministry of Commerce in the early 1980s followed, with Associate Professor Ren soon becoming the Grain Storage and Insect Control Division's director, a role that saw him provide grain storage advice to ensure the integrity of China's grain storages.

Following a stint with the UN's Food and Agricultural Organization, he moved to Australia, completing his masters and PhD of applied science in Canberra in the 1990s. Associate Professor Ren then joined CSIRO Entomology, leading the Grain Pest Technology and Chemical Strategy team.

Today he will continue to contribute to improving the productive capacity and profitability of the grains industry, by effectively managing the biosecurity risk to the food chain and developing new risk mitigation options.

Originally from China, Associate Professor Ren spent two years being 're-educated' during the country's Cultural Revolution, working as a farmer growing wheat, maize, cotton and sweet potato.