GRDC DRIVING AGRONOMY

TRIALS TEST 'NO OXYGEN, NO PESTS' THEORY

A Western Australian farming family is trialling a nitrogen-based technology that may control stored grain insect pests without pesticides

PHOTO: NICOLE BAXTER

WHEN PURGED OF ALMOST ALL OXYGEN (99.5 PER CENT), DOUG CLARKE (LEFT) CONNECTS EACH SILO TO A GASOMETER, WHICH IS DESIGNED TO KEEP THE OXYGEN CONTENT TO LESS THAN ONE PER CENT. HE CHECKS THIS BY LOOKING AT THE WATER LEVEL MOVEMENT IN A SMALL TUBE FITTED TO THE BASE OF EACH SILO.

By Nicole Baxter

■ Doug, Deb and Leon Clarke, who farm at Lake Grace in Western Australia's eastern wheatbelt, have spent more than $70,000 during the past 12 months developing a system to store grain without using pesticides.

The system being trialled comprises a nitrogen generator with pressure swing adsorption (PSA) technology, a condenser, and a diesel air-compressor with an add-on alternator to produce 240 volts of power.

When attached to a silo, the system removes oxygen and generates 99.5 per cent pure nitrogen, an inert gas that already comprises 78 per cent of the Earth's atmosphere. When nitrogen is pumped into the silo from the nitrogen generator, insects are simply deprived of the oxygen needed for life.

Inside the PSA is a carbon molecular sieve to separate oxygen from nitrogen. Large nitrogen molecules bypass a sieve and enter a storage tank, while smaller oxygen and carbon dioxide molecules are exhausted.

For about $100, Mr Clarke fitted three taps to the base of each silo. A hose from the nitrogen storage tank connects to one of these taps to purge the silo of oxygen.

Each silo has a thermosiphon pipe to allow nitrogen circulation through the grain.

Murdoch University stored grain expert Associate Professor YongLin Ren says that as a fumigant, nitrogen could offer many benefits.

"It is safe to use, environmentally friendly and its only operating cost is electricity. It also produces no residues, so grains can be traded at any time, unlike other fumigants that have withholding periods."

Mr Clarke adds that nitrogen is non-corrosive, unlike phosphine.

The Clarkes are collaborating with Associate Professor Ren, who has trialled nitrogen for controlling stored-grain insect pests in three wheat silos at Lake Grace.

To test the effectiveness of nitrogen, Associate Professor Ren inserted caged weevils into Mr Clarke's 75-tonne silos and removed the atmosphere by purging the bins for two-and-a-half hours with 30 cubic metres of nitrogen per hour.

Associate Professor Ren says the results appear encouraging. After seven days' exposure at 98 per cent nitrogen all red flour beetle (*Tribolium castaneum*) adults were killed without any impact on wheat quality. After 20 days, all pupae, larvae and eggs were also killed.

Mr Clarke estimates the cost of the technology at 12 to 15 litres of diesel for each 75t silo, equating to 16 to 20 cents per tonne of grain, excluding capital costs. Phosphine costs about 42 cents a tonne.

The research, supported by the Cooperative Research Centre for National Plant Biosecurity (CRCNPB), showed that purging oxygen from the bottom of the silo is more efficient than purging from top. The GRDC is one of the participants in the CRCNPB, contributing funding and undertaking collaborative activities.

Mr Clarke says although exposing each silo to 99.5 per cent nitrogen is ideal, it was not possible during the initial trials because the silos, although sealed, vent.

To overcome this problem, he has worked with Don Bird of Bird's Silos to develop a prototype gasometer to hold the nitrogen concentration steady. When the silos heat, nitrogen is vented into the gasometer. At night, when temperatures drop, nitrogen is sucked back into the silos.

"If silos are kept full of grain they don't vent as much," Mr Clarke says.

He hopes nitrogen and the gasometer will allow him to preserve the quality of a range of other high-value grains when held on-farm in his recently upgraded storage facility.

"Last year some growers were penalised when they sold their stored malt barley," Mr Clarke says. "This season we are hoping to test if nitrogen will allow us to hold malt barley on-farm without deterioration in germination rates."

Associate Professor Ren wants to investigate whether canola can be stored at higher moisture levels without spoilage, and test if nitrogen can overcome the oxidisation process that changes field pea and faba bean colour. "Having green peas to sell would be a particular advantage in Middle Eastern markets because it maintains the grain in its 'just harvested' colour."

Another opportunity Mr Clarke is exploring is developing a new supply chain to take his grain from farm through the ports for direct sale to Japanese grain buyers – one of the world's most discerning markets.

"In the future, buyers will become more discerning and the best way to avoid maximum residue limits is not to have any pesticide residues in our grain to start with," he says.

With further research, Associate Professor Ren adds that nitrogen could become a viable phosphine alternative. □

KEY POINTS

- Nitrogen a possible grain fumigant alternative
- Farmers trialling on-farm nitrogen technology
- Early trial results encouraging

THE FARM

Farmers: Doug, Deb and Leon Clarke
Location: Lake Grace, Western Australia
Annual rainfall: 350mm (200mm GSR)
Farm size: 4000 hectares (100 per cent cropped)
Rotation: Chemical fallow/wheat/wheat/canola or lupins
Soil type: Loam over clay (70 per cent) to sand over gravel
Soil pH: 4 to 7 (calcium chloride)

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