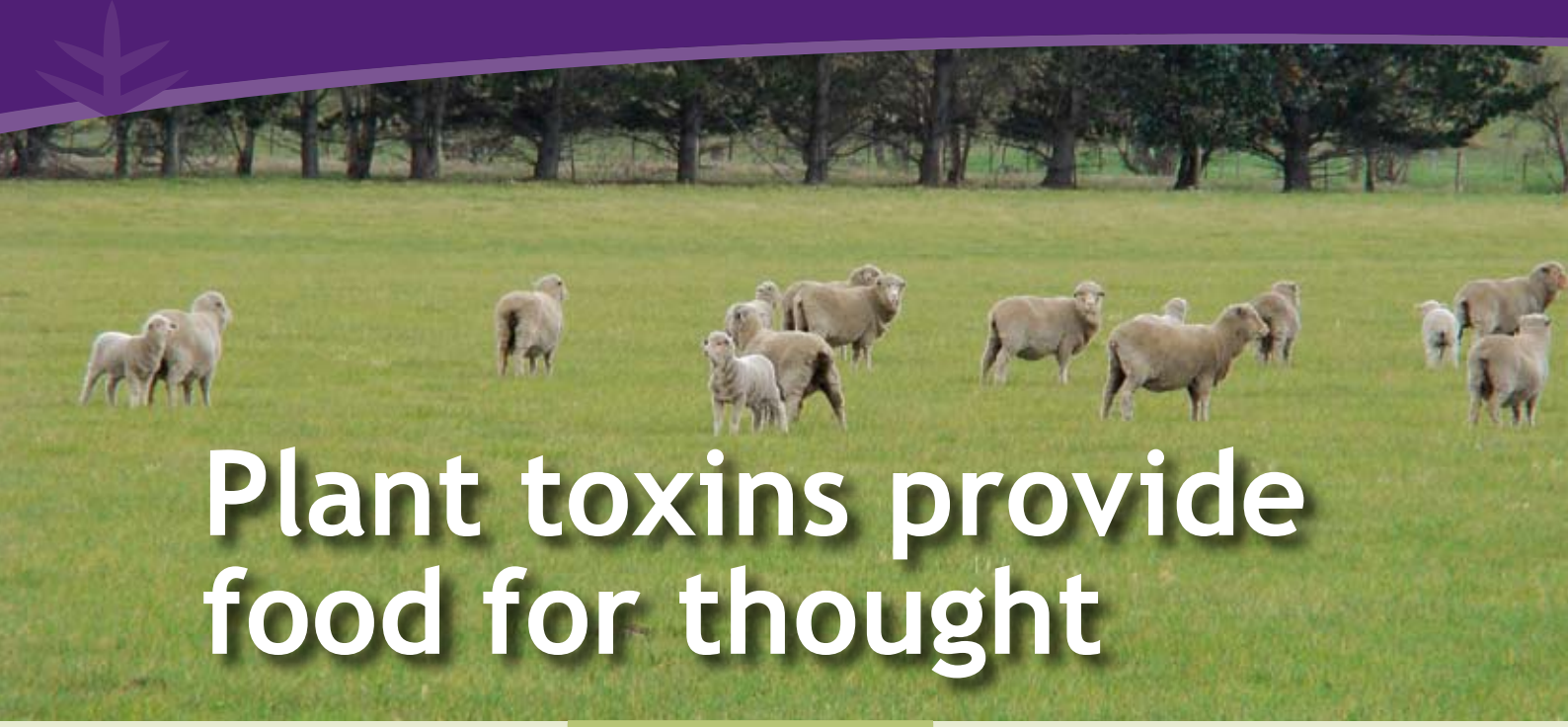

Plant toxins provide food for thought

By Catriona Nicholls
Kondinin Group

ABOVE: Perennial grasses can be safe and productive, but producers need to manage grazing to avoid potential toxicity issues. (Photo: Catriona Nicholls)

Recent cases of saponin-induced secondary photosensitivity in livestock in Western Australia highlight the need for careful management and development of potential new perennial pastures species. To maximise adoption of these species producers need to be confident stock can graze new pasture species without any health risks.

Pasture species, such as panic and signal grasses, continue to demonstrate their immense value to grazing enterprises, with their high palatability and nutritive value. But, lurking beneath the surface, chemicals called steroidal saponins, can cause significant disease or even death under certain conditions.

According to Department of Food and Agriculture, Western Australia (DAFWA) District veterinarian Dr Helen Spillman, three cases were investigated in areas surrounding Geraldton during early November 2008 and another during March 2009.

"The symptoms seen were similar across all mobs and all occurred in weaner sheep," Dr Spillman said.

key points

- Producers need to be made aware of any potential toxicity risks when grazing livestock
- Toxin levels can alter in plants according to active growth or plant stress
- Researchers developing new pasture options actively screen and breed for safe levels of known plant toxins.

Saponins and their damage

Saponins in plants such as panic and signal grasses cause liver damage, resulting in secondary photosensitisation.

"A healthy liver is responsible for breaking down many potentially dangerous chemicals so they can be safely used or removed from the body," Dr Spillman said.

"This condition arises in sheep and cattle when the liver can no longer break down the toxic by product of chlorophyll – the pigment which makes plants green.

"This product (phylloerythrin) is activated by light, so when it is circulating in the blood and close to the skin, it reacts with sunlight and causes tissue damage, or photosensitisation."

According to Helen, tissue damage can initially look like swelling under the skin, until the skin comes away to reveal raw sores. The areas of the body less protected by wool or dense hair are usually worst affected, such as the nose, ears and eyes.

With access to high-quality water and hay, livestock will usually recover. Although rare, occasionally tissue damage is severe around the eyes and lips, preventing the animal from seeing and grazing, possibly resulting in death from dehydration.

Because saponins damage the liver, animals cannot break down protein essential for growth and development.

"While the liver has an amazing capacity to regenerate, it is possible a severe case of photosensitisation or chronic exposure to saponins over time may inhibit the animal's future growth and production potential," Dr Spillman explained.

"If the liver damage becomes a chronic problem, future grazing may result in the problem reoccurring quickly."

Avoiding the risk

Saponin levels in plants are likely to vary greatly under different environmental conditions. It seems that secondary photosensitisation occurs when animals are grazing stressed plants. This is likely to occur during late spring and summer when rain is followed by a period of hot conditions.

Young animals are most at risk, and animals that could have had previous damage to their liver are more susceptible.

The message for producers is to avoid grazing stock on risky perennial species when plants are stressed and reduce selective grazing by using higher stocking densities for shorter time periods.

"Producers also can ensure a good mix of perennial plant species is available in the paddock," Dr Spillman advised.

"If producers must graze in risky conditions, they are best to use adult animals, which are less likely to be affected and monitor stock closely."

Breeding better pasture options

Plant toxins are just one of the factors that are foremost in a plant breeder's mind when looking for new or better-adapted perennial pasture options, according to plant ecologist Graeme Sandral, New South Wales Department of Primary Industries (NSW DPI).

"Researchers undertake a duty of care and screen all potential pasture species for possible toxicity."

RIGHT: Tissue damage from saponin-induced secondary photosynthesis is most likely to affect areas of the body less protected by wool or dense hair, such as the nose, ears and eyes. (Photo: Dr Helen Spillman)

"However, the biggest challenge when developing new plants, is that we can screen for known toxins, but occasionally come across unknown substances."

"We first test the plant material for known toxins and if the results are clear we go on to jump other hurdles, such as potential weed risk, productivity and persistence and whether seed production is prolific enough to allow the cost of seed to be economically viable as a commercial species."

Graeme explained that plant selection and breeding processes also include animal trials to measure production levels and investigate any further anomalies.

"After grazing livestock on the selected species, we check blood and liver samples and carry out taste tests on the meat produced by the livestock," he said.

Interestingly, meat taint may not always be a negative factor.

"We had a plant a while ago (*Trigonella balansae*), that sparked some interest from Sydney restauranteurs looking to get a market advantage by supplying an exclusive flavour," Graeme said.

Researchers also compare animal production levels from potential pasture species against existing species to ensure there are no production disadvantages.

Tackling plant toxins

If chemical screenings for plant toxins are identified, breeders do not necessarily throw in the towel.

Examples include white clover (*Trifolium repens*) and birdsfoot trefoil (*Lotus corniculatus*) both contain cyanide, but at very low levels.

If toxins exist at commercially unacceptable levels, researchers breed for lower levels if the plant shows particular merit in other areas.

"This may mean taking measurements at different times of the year," Graeme explained.

"When plants grow rapidly, toxins can be diluted and when they grow slowly they can be more concentrated."

This phenomenon also explains why grazing risk to livestock can be related to periods of plant growth.

Toxin levels also can increase when a plant is under stress, such as moisture stress or insect attack.

"Plants have evolved in nature to protect themselves against predation," Graeme explained.

"If they are under severe moisture stress, the last thing they want is an animal eating them.

"One way to protect themselves is with elevated levels of toxins. Other plants use different strategies to cope with predation or survival in challenging conditions, such as thorns.

"But through domestication and plant breeding, we have altered those things."

A key historical example is the oestrogenic sub-clovers, such as Dwalganup and Yarloop, which had devastating impacts on ewe fertility during the 1960s. As a result, there was a significant effort to reduce the oestrogen levels in new varieties.

Raising awareness

As researchers strive for better perennial options to support producers' efforts to maintain production and sustainability in a changing climate, it is clear that messages about best grazing practices need to incorporate strategies to prevent potential risks.

More information

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Profiling practice change

A national team of experts is providing insights and lessons from research into adoption of new practices by farmers and other rural landholders — and interest in their work is spreading.

During November 2008, more than 400 delegates attended a successful symposium held in Melbourne, Victoria to showcase the processes surrounding practice change by rural landholders.

This event attracted delegates from the public sector, regional natural resource management bodies, private consultants, media, agricultural input suppliers, universities, CSIRO and students. Videos and podcasts of presentations given at the Victorian symposium and associated papers are available from the *Rural Practice Change* website: www.ruralpracticechange.org.

The level of interest shown in this symposium has sparked another event in Perth, Western Australia, on July 8, 2009. The WA symposium will include several speakers from the original event, supplemented by a range of additional presenters.

The core of the team originally came together to prepare a journal article for the *Australian Journal of Experimental Agriculture — Understanding and promoting adoption of conservation practices by rural landholders.*

A paper written in response to the needs of the former Cooperative Research Centre for Plant-Based Management of Dryland Salinity (CRC Salinity), subsequently proved to be of interest to many others.

The motivation for the first symposium in Melbourne was to celebrate the paper becoming the most downloaded paper for that journal.

Like the popular paper, the symposium presented current thinking and evidence about drivers of practice change, timing of adoption and factors that influence the extent of practice change.

A wider appreciation

Understanding the process of practice change by rural landholders is crucial for policy makers, agricultural researchers, extension agents, environmental management bodies, non-government organisations and consultants.

While there is a vast research literature on the subject, it is often under-utilised in practice. One aim of symposiums of this kind is to provide key insights from past and current research and make them available in an understandable and useful form.

A second aim is for some groups involved in encouraging rural practice change to present their insights based on practical experience.

Registrations for the Perth symposium close June 19, 2009.

More information

W: www.ruralpracticechange.org/content/wa-symposium