Government of Western Australia
Department of Agriculture and Food

Industry update

Saponins in sub-tropical grasses in WA

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The Department of Agriculture and Food Western Australia (DAFWA) and the ChemCentre has investigated the cause of secondary photosensitisation that sometimes occurs in stock grazing sub-tropical grass-based pastures.

The majority of commercial paddocks of sub-tropical grasses are sown as a mix of two or more species. Some commercial seed mixes contain signal, panic and Rhodes grasses. Signal grass is often included in the mix for non-wetting sands. Its larger seeds and ability to germinate from depth act as an insurance against establishment failure from sowing too deep, or following sand in-fill from strong winds after seeding.

Steroidal saponins that are capable of causing secondary photosensitisation are reported to occur in signal grass (*Urochloa decumbens*) and panic grass (*Megathyrsus maximus*, syn. *Panicum maximum*), so the focus of the investigation has been on these two grasses. Rhodes grass (*Chloris gayana*) does not contain saponins.

Preliminary results released in July 2011 stated; "…. regular sampling of field trials in WA show that signal grass contains high concentrations of steroidal saponins and appears to be the main contributor to the saponin content in perennial grass-based pastures. It seems likely that it is the pasture species responsible for the sporadic cases of photosensitisation that may occur."

These preliminary results came from samples collected in a limited geographic area, so more extensive sampling was undertaken as part of the DAFWA-Caring for our Country project 'Transforming the Northern Sandplain'.

Methods – field sampling

The aim was to sample commercial paddocks from a wide geographic area to determine the prevalence of sub-tropical grasses containing concentrations of saponins that could potentially cause photosensitisation.

Six field sites were established on commercial properties from West Binnu to Gingin, a north to south distance of approximately 450km. Perennial grass paddocks with a good density of both panic and signal grasses were selected. At each site four pasture cages were set-up to ensure that samples could always be collected, even if the paddock had been recently grazed. The wide geographic spread of sites allowed for the effect of differences in temperature, frost frequency (nil frosts in north) and seasonal and out-of-season rainfall to

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be evaluated.

On average the sites were sampled five times between 30 November 2011 and late December 2012, with a total of 113 samples collected. At each visit to a site, two samples of both panic and signal grass were usually collected from plants with different growth stages (e.g. fresh growth from paddock, older growth from pasture cages). The parts of the grasses sampled were carefully selected to simulate grazing. Collected samples were immediately placed in a vehicle fridge (semi-frozen), before being stored in a freezer and subsequently freeze dried prior to analysis.

Sampling site east of Geraldton (photo - December 2011)

The samples were analysed by the ChemCentre for the presence of three saponins: dichotomin, protodioscin and dioscin, the main saponins cited in the literature. The saponins present vary in the different pasture species. Signal grass contains predominantly protodioscin with some dioscin, panic grass contains protodioscin, while Bambatsi panic (*Panicum coloratum*) contains predominantly dichotomin with some protodioscin.

To become toxic, all three saponins are metabolised in the animal to the sapogenin - diosgenin. To compare the cumulative effect of the three saponins (dichotomin, protodioscin and dioscin) the results for each were converted to diosgenin equivalents. A review of the literature showed that protodioscin concentrations of 0.3-2.56% had been associated with photosensitisation, so in this study a critical value of 0.2% (2mg/g) protodioscin is used. The comparable critical value for diosgenin equivalents is 0.08% (0.8mg/g).

Results

The results for panic and signal grasses by sampling time are summarised in Figure 1. All of the signal grass samples had high to very high concentrations of diosgenin equivalents (5.9-24.1mg/g), 7-30 times above the 0.8mg/g critical value. The signal grass contained

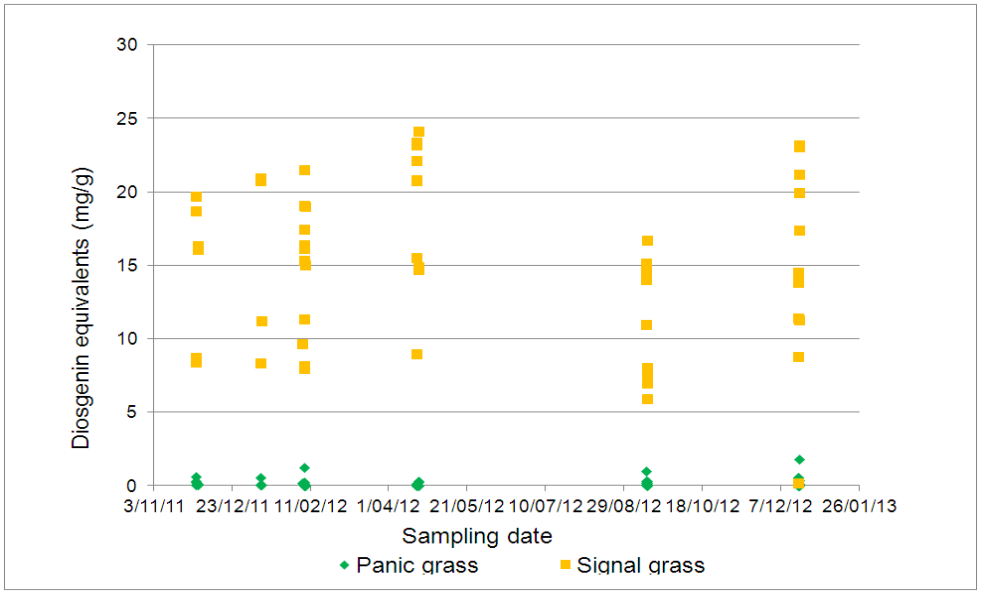

Figure 1. A summary of saponin concentrations (diosgenin equivalents, mg/g) in panic and signal grasses by sampling date

high to very high concentrations of protodioscin, and moderate to high concentrations of dioscin.

For signal grass there was no relationship between saponin levels (diosgenin equivalents) and sampling date or location (Figure 2). At sampling the grasses were visually assessed for their level of stress using a 0 (nil stress) to 5 (dead) scale, and it was noted whether the stress was predominantly caused by moisture deficit or cold stress. There was no relationship between the 'stress' rating and the saponin levels (diosgenin equivalents).

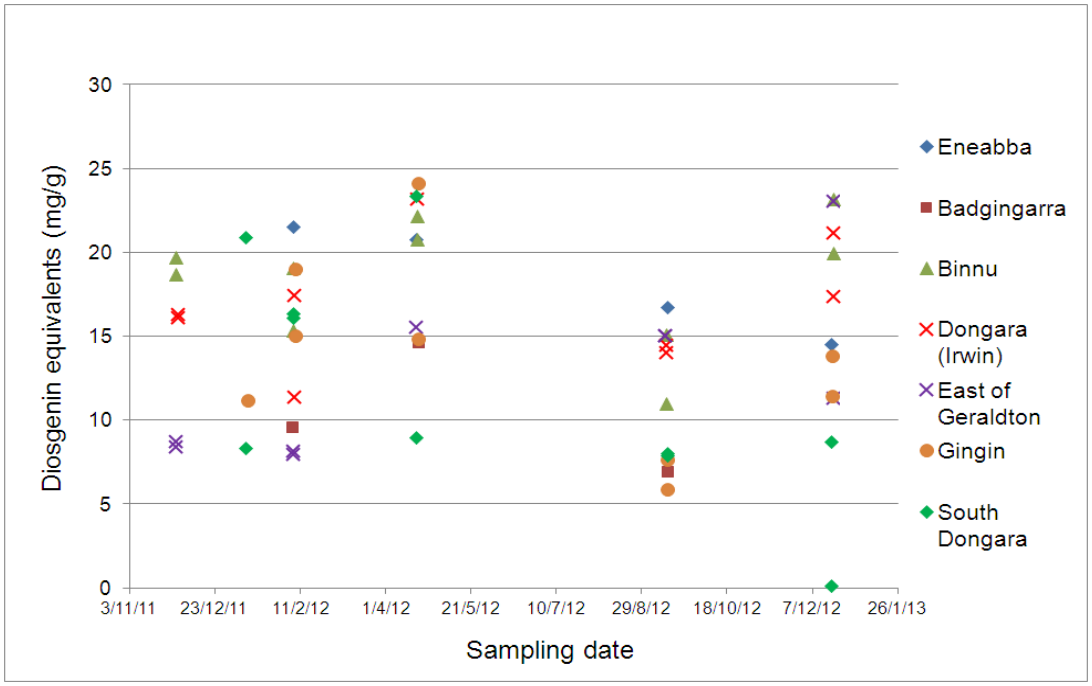

Figure 2. Saponin concentrations (diosgenin equivalents, mg/g) in signal grass by sampling date and location

The panic grass generally had very low concentrations of diosgenin equivalents (<0.1-1.8) (Figure 1), with only three of 59 samples being above the 0.8mg/g critical value (1.0, 1.3 and 1.8mg diosgenin equivalents/g) (Figure 3). In previous field samplings of panic grass in Western Australia (>40 samples), none have been found with concentrations above the critical level. In total, 40% of all panic grass samples tested have had non-quantifiable

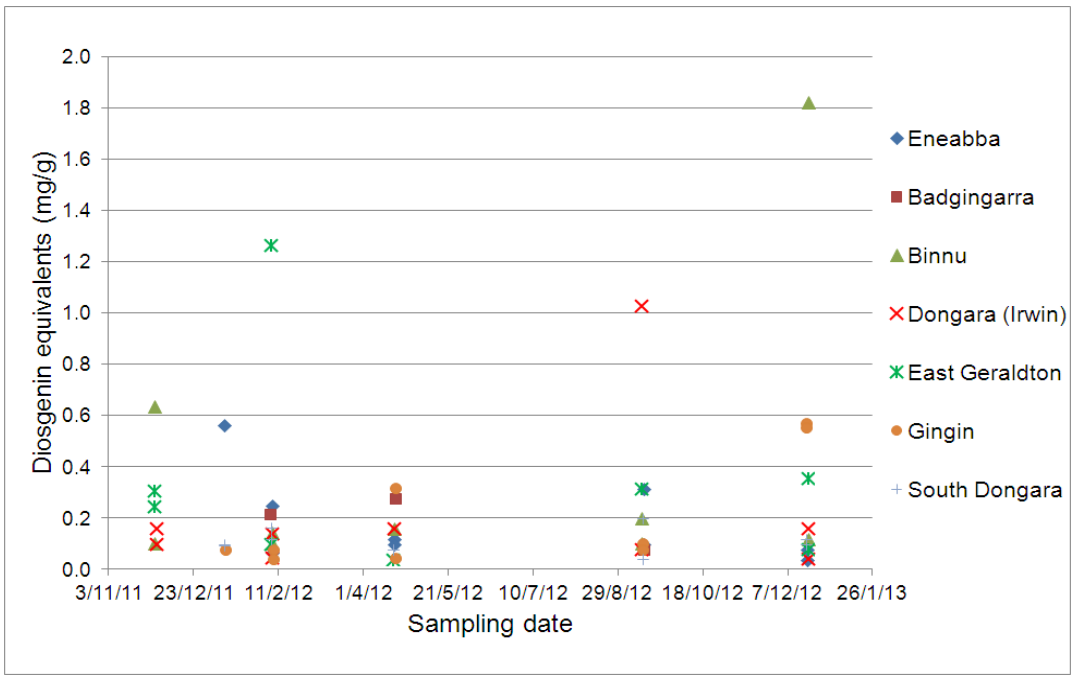

Figure 3. Saponin concentrations (diosgenin equivalents, mg/g) in panic grass by sampling date and location

concentrations of saponins (<0.04mg diosgenin equivalents/g). Panic grass samples contained only protodioscin.

Discussion and conclusion

The results of this survey indicate that signal grass growing in the field in Western Australia has high to very high concentrations of saponins all year round. Therefore, there is always a potential health risk to livestock grazing pastures containing signal grass, whether the plants are stressed or not. These results reinforce the earlier conclusion that signal grass is the main cause of secondary photosensitisation in stock grazing sub-tropical grass-based pastures in this state. Consequently, the Department of Agriculture and Food WA recommends not sowing signal grass either alone or as a component of sub-tropical grass mixtures.

For existing perennial grass-based pastures, producers need to be vigilant when grazing livestock on pastures containing significant amounts of both signal and panic grasses. The risk of secondary photosensitisation is heightened when the perennial grasses represent all or most of the palatable green feed-on-offer.

Signal grass plants at different sampling times and locations – all contained high to very high concentrations of saponins

For paddocks containing panic grass, but no signal grass, the risk of photosensitisation is considered minimal. Nevertheless, producers need to monitor stock regularly when the panic grass represents all or most of the palatable green feed-on-offer.

It is important to note that the majority of pastures containing a mix of perennial grasses, including signal grass, have not caused any issues in stock that have grazed them. It seems that an appropriate interaction of weather, pasture, grazing and animal factors is required before the potential for photosensitisation occurs. This happens infrequently and only for short periods of time, explaining why these pastures are usually productive.

Young animals are the most susceptible to saponin-induced photosensitisation, so short and hard grazing periods with adult animals may help to avoid this problem. Also graze the paddock while the Rhodes grass is still palatable to ensure the stock have a mixed diet. This will dilute the saponins intake by the animals. Early detection of the signs of photosensitisation, immediate removal of the stock from the pasture, preferably onto dry feed (e.g. hay) that doesn't contain chlorophyll, and the provision of shade, will significantly minimise any reduced production that may be caused by this condition.

Acknowledgements

This research has been funded by DAFWA, the ChemCentre, the Cattle Industry Compensation Fund and the Caring for our Country 'Transforming the Northern Sandplain' project. The project team would like to thank the producers who allowed access to their paddocks for sampling the sub-tropical grasses.

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