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Biology, toxicity and management of ergot in sorghum

DISEASE UPDATE

Sorghum ergot is caused by a fungus, *Claviceps africana*. The disease reduces yield through poor seed set and causes harvesting difficulties due to sticky honeydew on seed heads. Grain quality can be reduced through lower nutritional value and due to the presence of fungal bodies called sclerotes (ergots). Sorghum grain contaminated with sclerotes can cause toxicity when fed to livestock, particularly sows, dairy cattle and beef cattle in feedlots. Currently in Queensland and NSW there is a stockfeed limit of 0.3% sclerotes by weight for sorghum.

Honeydew and white immature sclerotes

White honeydew after production of infective spores

Infection occurs during flowering, when spores of the fungus land on the feathery stigmas of flowers in sorghum heads. If the flower has not been fertilised, the spore germinates and grows into the unfertilised seed (ovary) and the ovary is rapidly replaced by a fungal mass. About seven days after infection, sticky honeydew oozes out of the flowers and drips onto leaves and the ground. When the weather is wet and/or humid, the honeydew turns white due to the production of the infective spores just above the surface of the honeydew. Ultimately (near grain maturation), the fungal mass develops into a hard fungal body - the sclerote. Occasionally the developing sclerote can be overgrown by the black fruiting body of another fungus called *Cerebella*. If the flower has been fertilised by pollen it resists infection and normal seed will develop.

Survival

The fungus can survive year-round in honeydew on other *Sorghum* hosts, such as Johnson grass *(Sorghum halepense)* and columbus grass *(Sorghum almum)*. Control of these hosts may help to reduce ergot levels in grain crops. The ergot which affects sorghum **does not** infect paspalum or winter cereals such as wheat and barley. There is some evidence that spores of the fungus can survive on dead infected sorghum heads over winter in southern Queensland, but the importance of this method of survival is unknown. Although ergot spores can survive in honeydew on sorghum seed, the fungicide thiram that is used routinely on sorghum planting seed will kill the spores. Sorghum ergot does not survive from season to season in sorghum stubble or as sclerotes in the soil.

Queensland Government
Department of Primary Industries

By Malcolm Ryley and Barry Blaney

High risk situations

The availability of pollen has a large influence on ergot outbreaks. High risk situations are:

- Poorly-pollinated grain sorghum crops
- Tillers on grain sorghum crops
- Many forage sorghum varieties
- Male sterile lines in seed production blocks
- Ratoon sorghum crops.

Conditions favouring infection

Ergot can occur at any time during the growing season if suitable weather conditions occur. In experiments, a constant temperature of 20°C and relative humidity close to 100% favours maximum infection. Outbreaks in main heads during summer are associated with at least two days of rainy weather, with daily maximum temperatures below 28°C. There is a trend for increasing ergot severity as the temperatures drop towards the end of the growing season. The requirement for rainfall seems to be less critical, perhaps because dew periods are common during this period.

For late tillers, forage sorghums and male sterile lines, infection can occur under a much broader range of conditions due to the naturally lower pollen production in these situations during flowering.

Clockwise from top left: immature sclerotes, mature sclerotes, sorghum seed, immature sclerotes covered with the fungus, *Cerebella*.

From left to right: sorghum seed and sclerotes clumped together with honeydew, normal sorghum seed.

What are toxic ergot levels in grain and crops ?

Sclerotes of C. *africana* contain toxic chemicals, in particular the alkaloid dihydroergosine. Feeding trials have established that sorghum contaminated with sclerotes can affect milk production in cows and sows, and weight gain in cattle. There is a large variation in the levels of alkaloids (and toxicity) between ergot-contaminated grain samples, which is caused by differences in the maturity of the sclerotes and perhaps other factors such as weather and variety.

There is currently a stockfeed limit of 0.3% sclerotes by weight in sorghum grain. This level equates to approximately 1 sclerote per 100 seeds or 30 sclerotes per 100 g grain. The three types of sclerotes in the left, top photo are counted. Deliveries of sorghum with sclerote levels higher than 0.3% will be rejected by grain merchants. Most commonly, a sorghum sample containing 0.3% sclerote will contain about 1 mg alkaloid/kg (1 ppm), and all experimental results quoted below relate to that alkaloid concentration. However, because the alkaloid concentration can vary, it will be advisable to minimise ergot wherever possible. Floatation techniques (see Estimating sclerote levels in grain section) can be useful for quickly counting sclerotes, and analytical tests can be used to quantify alkaloid levels (see Marketing options section).

Effect on pigs

In controlled experiments, sows fed 0.6-1% ergot sclerotes prior to farrowing produced little or no milk, leading to loss of the litters. Ergot had less impact on sows in full milk production, but reduced piglet growth occurred with 1% sclerotes. The regulated limit of 0.3% sclerotes was tolerated by sows, but there were indications that some first-litter gilts might have reduced milk production with 0.3%. Feeds with 1% ergot were tolerated by growing pigs (greater than 20 kg) and boars without ill effect. Consequently, the limit of 0.3% is safe for all classes of pig, possibly except for gilts and young pigs (less than 20 kg), where 0.1% is preferable.

Effect on dairy cows

In experiments, cows in early or mid-lactation were given a sorghum grain-based concentrate (5 kg sorghum/day), while also being fed silage and grazing improved pastures, so that the grain represented about 40% of the total dry feed intake. Ergot concentrations of 0.6-4% in the sorghum grain reduced milk production at rates dependent on the amount of ergot fed - with 1% ergot, milk yield declined by 30% after 5 weeks, and took even longer to recover after ergot was removed from the ration. Ergot concentrations of 0.3% did not affect milk. If cows were on a full grain ration, the limit would have to be reduced to 0.1% sclerotes.

Effect on lot-fed cattle

Sorghum ergot reduced the ability of cattle to shed heat, which in turn reduced feed intake and growth. Experiments indicated that this was worse in warm conditions with high humidity. While 0.3% ergot was tolerated in winter, in summer the limit tolerated was less. A limit of 0.1% is recommended, but in very hot and humid conditions it is possible that even traces of ergot might have some effect on susceptible cattle, particularly larger, fatter animals which shed heat less effectively. If cattle show signs of heat stress, do not attempt to drive them, or collapse and death from heat stroke might occur. Quietly move onto alternative feed and they should recover.

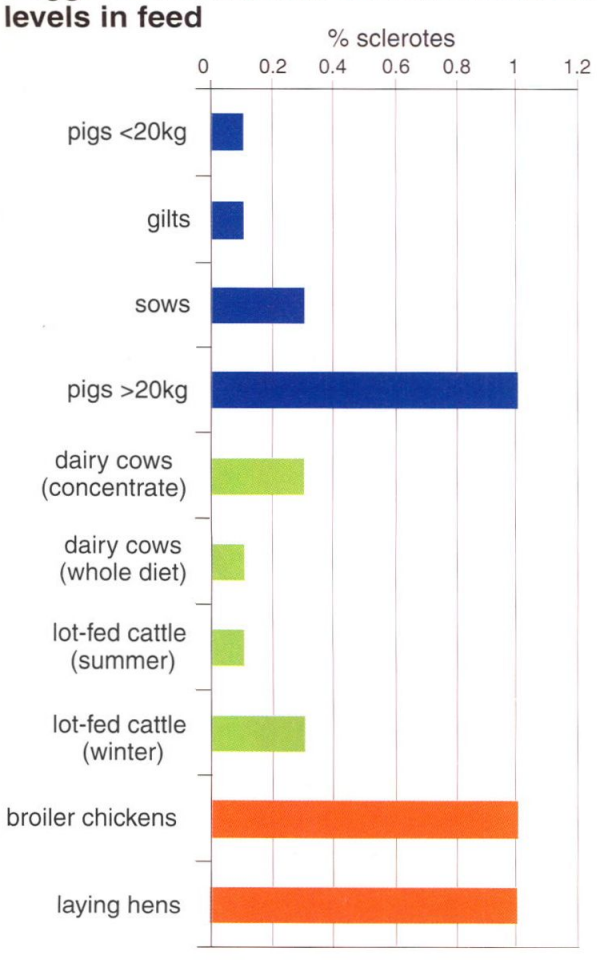
Effect on chickens

Experiments have shown that both broiler chickens and laying hens are relatively tolerant of sorghum ergot. Sorghum containing 2% sclerotes has been fed with only very minor effects on production. The regulated limit of 0.3% sclerotes is quite safe for chickens and hens.

Effect on other livestock species

Effects of sorghum ergot on poultry other than chickens, on sheep, goats, horses, etc. have not as yet been tested. However, it seems likely that other poultry will tend be somewhat resistant to ergot, while sheep and goats might show similar effects to cattle.

Suggested maximum tolerable sclerote levels in feed



Estimating sclerote levels in grain

Spread out about half a cupful (100g) on a clean sheet of white paper, and begin to separate the components. After removing sound grain, look for small, grey/white bodies. Sclerotes look a bit like immature sorghum grain, but are more elongated and darker in colour, with a scaly surface, and often with a small black tip where the *Cerebella* fungus is taking hold. A small magnifying glass costing a couple of dollars is very helpful in this process. If less than 30 sclerotes are found the sample should contain less than 0.3% by weight. Another quick method to judge the general quality of the grain and to separate sclerotes is to float off the lighter material in a salt solution. To do this, dissolve 20g of common table salt in 200ml of tap water. Add 100g of the grain and stir briskly. Take off the material that floats with a spoon and dry on absorbent paper. Examine as described above. The material that floats will include sclerotes, ergots with *Cerebella*, immature grains, weed seeds and glumes/chaff.

Reducing the impact of ergot in forage sorghum

Little is known about the effect of ergot on livestock grazing on infected forage sorghum, but on occasions honeydew contains alkaloids at high enough levels to impair livestock performance. The risk will vary depending on whether cattle preferentially select infected heads. If cattle are grazing on infected forage sorghum crops, they should be watched closely for signs of ergot poisoning. These include signs of overheating such as excessive salivation, seeking shade and standing in water. DO NOT DRIVE affected stock - move them quietly onto alternative feed during a cool time of day. The effect of ergot on the quality of sorghum hay and silage is not known. Preferentially, **forage sorghum should be grazed or cut for silage before flowering**, particularly in late summer-early autumn.

Reducing the impact of ergot in grain sorghum

Before sowing

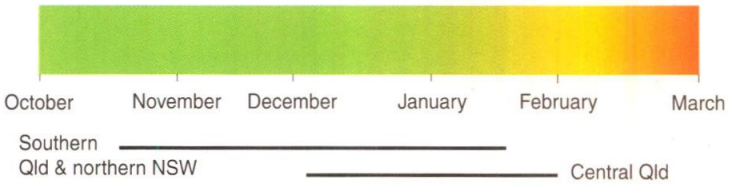
Minimise uneven flowering by -

- planting in a paddock with even soil type and preparation
- sowing on a good soil moisture profile
- ensuring correct soil nutrition levels
- using high quality seed

At sowing

- sow during the optimum planting window
- in lower yield situations plant wider rows (1m or skip) ensuring the same plant population per hectare, as this will reduce tillering

Planting times to minimise sorghum ergot



During crop growth

Honeydew in tillers can pose a threat to harvesting operations especially if harvesting is delayed or if the crop is planted late. Killing tillers with a herbicide such as glyphosate is an option. Glyphosate can only be applied when the seeds in the main head are at or beyond the "dough stage"; that is, less than 25-30% grain moisture and when a small black layer appears at the base of the seed. Honeydew in sprayed tillers will dry up rapidly after the tillers die. Follow herbicide label directions closely.

At harvest

- The sclerote limit of 0.3% by weight in a grain sorghum sample is equivalent to approximately 1% (or 20) of the grains in a sorghum head, assuming 2,000 seeds per head and no reduction in sclerote numbers during harvest.
- Sclerotes are much lighter than grain, so during harvesting a high proportion (30-90%) is blown from the back of the header. Increasing the fan speed can increase the percentage of sclerotes that are ejected, but must be selected to ensure that small-sized, clean grain is not lost.

MORE INFORMATION

- Higher levels of ergot infection tend to occur at the edges of crops, and where flowering has been uneven. Infected areas can be harvested separately from the rest of the crop and either discarded or diluted with uncontaminated grain.

After harvest

- Grain with high levels of sclerote contamination can be mixed with grain with no or very low levels of contamination, to reduce the sclerote level to less than 0.3% by weight.
- Using sieve and/or gravity table graders can reduce ergot levels significantly, depending on the size of sclerotes in the sample and size of grain.

Marketing options for ergot-contaminated grain

Although there is a 0.3% sclerote contamination limit for sorghum intended for livestock, some end users will not accept ergot-contaminated grain. Grower pigs, chickens and laying hens are most tolerant of the alkaloids in sclerotes, so are a potential market for sorghum that contains less than 0.3% sclerotes. Sorghum with levels higher than the stockfeed limit can be mixed with clean grain to reduce the sclerote levels. Fortunately, the incidence of ergot contamination of bulk grain has been extremely low over the past few years. If large amounts of sorghum become ergot-contaminated in future years, then alkaloid estimation should be undertaken in order to fine-tune end-uses. A range of effective analytical tests have been developed for this purpose. Currently these tests are provided by DPI (see below for contacts), but additional laboratories will eventually be able to provide this service.

Variety selection

All current commercial grain sorghum varieties are susceptible to ergot infection under adverse weather conditions. If planting late, consider a variety with a low tillering capacity. Some sorghum lines from Africa have good resistance to ergot, and breeding is underway to attempt to transfer this resistance to high-yielding grain sorghum varieties.

Contact: DPI Call Centre Phone: 132 523

Interstate Contact: Phone: (07) 3404 6999 Website: www.dpi.qld.gov.au

Further Information on sorghum ergot

Contact your local DPI Client Services Centre, regional agronomist, DPI Call Centre (132 523 for the cost of a local call), Malcolm Ryley on (07) 4688 1316 for general enquiries, or Barry Blaney (07) 33629470 for enquiries on toxicity and alkaloid testing.

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