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Sheep infertility from pasture legumes

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Summary: Some pasture legumes contain chemicals called phyto-oestrogens, which can affect the reproductive system of sheep. Many subterranean clover varieties and other clovers, such as red clover, contain high levels of the phyto-oestrogen formononetin. In the long-term, ewes grazing green pastures with high formononetin levels suffer reduced fertility, while short-term effects can include a prolapsed uterus, difficult lambing and a declining lambing percentage. While the introduction of new low-oestrogen pasture varieties and more effective flock management have reduced the incidence of sheep infertility, continued monitoring for signs of clover infertility is still required. Medics and lucerne can contain high levels of the phyto-oestrogen coumestrol, particularly in response to disease stress.

In areas where subterranean clover is oestrogenic it would be wise to buy rams from a breeder (in a similar area) with high levels of flock fertility. These rams should produce progeny with resistance to the development of clover infertility.

Infertility from subterranean clovers

Some older varieties of subterranean clover (and most red clovers) contain high levels of phyto-oestrogens, which can affect the sheep reproductive system. As far as sheep are concerned the most active isoflavone is formononetin, which can cause a decline in ewe fertility. Two other isoflavones, genistein and biochanin A, are also present in all subterranean clover varieties, but these have less impact on fertility than formonenetin. Ram fertility is not affected by phyto-oestrogens.

Dinninup, Dwalganup, Yarloop and Tallarook subterranean clovers contain high concentrations of formononetin and are particularly potent to sheep, while Geraldton sometimes causes sheep infertility problems. Esperance, Enfield and Meteora and some older variants of Seaton Park have moderate potency. A re-selected low formonotenin version of Seaton Park was re-released during the early 1990s and is now the most commonly sold form of this variety.

Other subterranean clover cultivars and the varieties of most other pasture legume species (apart from red clover) generally have low formononetin levels and are considered safe (see Table 1). Annual medics, lucerne and white clover do not contain significant levels of formononetin, but can contain other phyto-oestrogens (see following sections).

Formononetin is present in subterranean clover only while the pasture is green. However, hay produced from oestrogenic varieties can be almost as potent as green pastures. Formononetin levels drop away during late flowering. Generally, dry subterranean clover pastures that result from normal haying-off are not oestrogenic. However, if there is a very early finish to the season, it is possible for oestrogenic varieties to retain some potency in the dry state.

If sheep are mated when they are grazing green, potent subterranean clover their reproductive performance can be temporarily impaired. Continued exposure to high levels of formononetin can lead to permanent infertility. This can occur when potent subterranean clover-based pastures are grazed in winter and spring over several years.

Historical development

Clover infertility was a severe problem in the 1960s for sheep grazing subterranean clover-dominant pastures, particularly on new land. These pastures were often dominated by the highly oestrogenic Dwalganup or Yarloop cultivars. In some ewes, the uterus prolapsed through the vulva while other ewes suffered dystokia (difficult lambing) and appeared unable, or disinterested in, delivering their lambs. Frequently, the lamb and ewe died before delivery. Other ewes became infertile and lamb marking rates fell to 20 - 40 per cent, in a condition known as ‘clover disease’.

Some wethers also died because of swollen bulbourethral glands and blocked urethras. When the subterranean clover content of pastures declined, signs of clover infertility also decreased.

Table 1. Oestrogenic potencies, related to formononetin levels, of some commercially available pasture legume varieties

Species		Potency			
		Safe		Moderate	High
Subterranean clover	*Trifolium subterraneum*	Antas(PBR)	Leura(PBR)	Enfield	Dinninup
		Bacchus Marsh	Losa(PBR)	Esperance	Dwalganup
		Campeda(PBR)	Mintaro(PBR)	Meteora	Geraldton
		Clare	Mt Barker		Tallarook
		Coolamon(PBR)	Napier(PBR)		Yarloop
		Daliak	Northam		
		Dalkeith	Nuba		
		Denmark(PBR)	Nungarin		
		Gosse(PBR)	Riverina(PBR)		
		Goulburn(PBR)	Rosedale		
		Green Range	Seaton Park (LF)		
		Izmir(PBR)	Trikkala		
		Junee	Urana(PBR)		
		Karridale	Woogenellup		
		Larisa	York(PBR)		
Red clover	*Trifolium pratense*	Redquin		Astred(PBR)	Claret(PBR)
				Quinequeli	Pac19
					Pawera
Rose clover	*Trifolium hirtum*	All known varieties			
Strawberry clover	*Trifolium fragiferum*	All known varieties			
Balansa clover	*Trifolium michelianum*	All known varieties			
Persian clover	*Trifolium resupinatum*	All known varieties			
Arrowleaf clover	*Trifolium vesiculosum*	All known varieties			
Crimson clover	*Trifolium incarnatum*	Caprera			
Gland clover	*Trifolium glanduliferum*	Prima			
Eastern star clover	*Trifolium dasyurum*	All known varieties			
Purple clover	*Trifolium purpureum*	All known varieties			
Cupped clover	*Trifolium cherleri*	All known varieties			
Cluster clover	*Trifolium glomeratum*	All known varieties			
Woolly clover	*Trifolium tomentosum*	All known varieties			
Hop clover	*Trifolium campestre*	All known varieties			
Hares foot clover	*Trifolium arvense*	All known varieties			
Serradellas	*Ornithopus* spp.	All known species and varieties			
Biserrula	*Biserrula pelecinus*	All known varieties			
Sulla	*Heysarum coronarium*	All known varieties			
Lupins	*Lupinus* spp.	All known species and varieties			

(PBR) PBR symbol:

The present problem

Obvious signs of oestrogenic problems are now rare on most properties as pastures are less clover dominant and new, low-oestrogen cultivars have become more widespread. However, in many flocks, a proportion of ewes have developed low fertility and careful examination shows that their genital tracts have changed. Interestingly, lambing percentages of these flocks are usually normal, as improved nutrition has lifted the lambing percentage of fertile ewes.

Clover infertility results in permanent damage to the reproductive tract. It becomes worse with each year's exposure to oestrogenic pastures. In healthy flocks ewe fertility increases until the fourth or fifth lambing, but this might not occur in flocks affected by oestrogenic pastures (Figure 1).

Although permanent infertility normally occurs only after at least two years of grazing on oestrogenic pastures, lambs dropped onto oestrogenic pasture may take in formononetin and consequently some may be infertile at the maiden lambing.

While most ewes in the flock are affected to some extent, the damage in any one ewe is usually small, so 'double-dry' ewes are rarely a problem. However, as the disease progresses, individual ewes may become so badly affected that they have little chance of conceiving. In this situation, culling barren ewes may lift overall flock fertility.

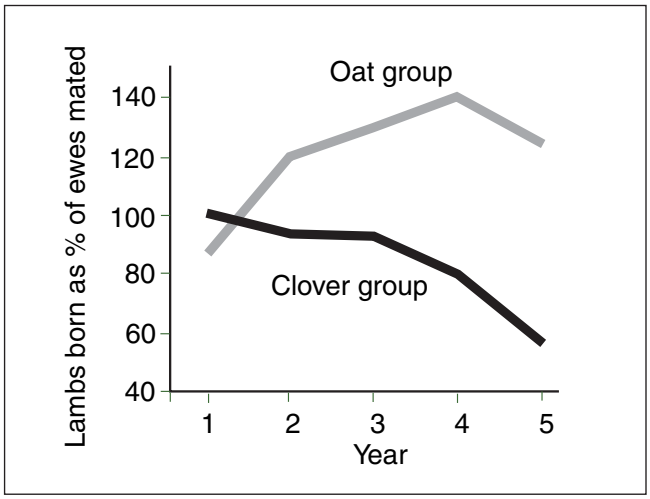

Figure 1. The percentage of lambs born to two groups of ewes grazed on oestrogenic clover or oat pasture at Avondale Research Station

Detection of clover infertility

On-farm

Even small amounts of plant oestrogens can cause ewes or wethers to lactate, so if barren ewes have fluid in their mammary glands at lamb marking the pastures can be assumed to contain some oestrogen.

The appearance of the vulva changes in ewes grazing on oestrogenic pasture. The clitoris may grow and become visible. This can be seen by comparing the normal vulva with the vulva from an infertile ewe in the following photographs.

In many ewes, a thin band of tissue grows across the lips of the lower part of the vulva. However this change can also be promoted by mulesing, so it may not be indicative of clover infertility. The appearance of the vulva gives an experienced operator a quick guide to a flock's exposure to clover oestrogens.

Laboratory

Clover infertility prevents fertilisation by impairing the transport of sperm to the site of egg fertilisation, the oviduct. By flushing the oviducts three or four days after mating and examining the eggs under a microscope, it is possible to see how many eggs have been fertilised.

Sperm transport is impaired because of damage to the cervix during clover infertility. The cervical mucus becomes more watery and cannot be drawn out into a thread. However the mucus naturally becomes less watery as the breeding season progresses, so it is difficult to compare groups of ewes sampled at different times.

The disease can be diagnosed by microscopic examination of cervical sections collected from ewes at the abattoir. The examination of the cervix is considered a specific diagnostic test for clover infertility.

Prevention of clover infertility

On established land, oestrogenic pastures can be oversown with appropriate less-oestrogenic clover varieties (see Table 1). Replace oestrogenic varieties with safe ones by cropping or spraying out existing clover before seed set. Do this for at least two years before re-sowing with safe varieties as subterranean clover normally sets large amounts of seed, some of which can remain in the soil as hard seeds for several seasons.

Before re-sowing with safe varieties, spray out any clover that germinates after the break of season. The aim is to maximise the proportion of safe varieties in the pasture. Re-sowing is an effective method of preventing clover infertility only if the sown clovers successfully displace oestrogenic varieties.

The common oestrogenic varieties are generally well adapted and may eventually re-dominate the pasture, making further re-sowing necessary. However, most recently released low-oestrogen varieties perform well in mixtures.

The oestrogenic potency of subterranean clover is fairly constant throughout the growing season until late flowering, when it declines. However, potency rises if pasture growth is hindered. Therefore, ensure adequate fertiliser is provided including phosphorus, sulphur, potassium and trace elements. Pastures containing grasses and weeds are less potent than clover-dominant ones, because the intake of clover is diluted.

Ewe weaners and hoggets should be grazed on low-oestrogen pastures. This will delay their exposure to excessive amounts of formononetin and avoid an early depression in fertility.

Some farmers combat clover infertility by joining more rams with the ewes for longer.

Excessive dosing with cobalt bullets can make the problem worse and should only be done after seeking advice from a veterinary officer.

The future of clover infertility management

For many years a small, but significant, depression in the fertility of ewes grazed on subterranean clover pastures has been tolerated. Where pastures contain oestrogenic clover, ewe fertility will be affected to some degree. Only by re-sowing with non-oestrogenic varieties will the problem be overcome.

The vulva region of two ewes. Photograph 1 (left). Normal vulva. Photograph 2 (right). The enlarged clitoris of an infertile ewe.

Interestingly, in flocks grazed on oestrogenic clovers some ewes do not develop the same degree of infertility as others. Such resistance to the development of infertility is heritable. This suggests that in areas where subterranean clover is oestrogenic it would be wise to buy rams from a breeder (in a similar area) with high levels of flock fertility. These rams may produce progeny with resistance to the development of clover infertility.

Infertility from medics, lucerne and white clover

Annual medics, lucerne and white clover can produce coumestrol, another phyto-oestrogenic compound that affects ewe fertility. All varieties of these species are capable of producing high levels of coumestrol, particularly when grown under stress. Subterranean clover and other commercially available clovers do not produce significant quantities of coumestrol.

The most common factor stimulating coumestrol production is leaf infection by fungal diseases. Insect damage, virus infection and poor plant nutrition can also lead to increased coumestrol levels.

Coumestrol levels in diseased medic varieties increase as the season progresses and reach a maximum when the pasture has hayed-off. This is the opposite of formononetin levels in subterranean clover, which are markedly reduced as the pasture hays-off. With lucerne and white clover coumestrol levels do not vary greatly with stage of growth. Legume density will influence the oestrogenicity of the pasture. The presence of grasses and weeds act to dilute the coumestrol concentration in the pasture.

The impacts of coumestrol on ewe fertility are usually less severe than those caused by formononetin. The main effects are reduced ovulation and delayed oestrus. Recovery of fertility is usually rapid following removal of sheep from oestrogenic pasture. There have been no reports of permanent effects of coumestrol on fertility.

The situation in Western Australia

In most areas of Western Australia, rams are usually joined with ewes in paddocks containing dry feed. Where annual medic pastures are grazed during joining, there is therefore potential for a reduction in ewe fertility, if high coumestrol levels are present.

Field trials involving annual medics infected with leaf fungal diseases, such as Phoma and Pepper Spot, have shown that high levels of coumestrol can develop in dense, ungrazed and heavily infected medic stands. Such levels would reduce ewe fertility.

Surveys of dry, annual medic pastures in Western Australia suggest most medic pastures contain low coumestrol levels and are not very oestrogenic. Most paddocks sampled had low levels of disease and many also had low medic densities. Occasionally the surveyed paddocks had very high coumestrol levels, which would probably cause a drop in ewe fertility. These paddocks contained dense stands of medic with severe infections of leaf fungal diseases,

Prevention of infertility from coumestrol

Annual medic pastures should be inspected late in the growing season for the presence of leaf fungal diseases. Lucerne and white clover pastures should also be inspected before joining. Bulletin 4133 ‘Fungal diseases of pasture legumes in Western Australia’ describes and illustrates symptoms of diseases likely to be encountered.

If pasture legume plants are heavily diseased, join ewes in other paddocks. After successful mating, ewes can be safely moved on to the diseased pasture. Wethers can graze diseased pastures while ewes are being mated on non-diseased pastures.

To reduce the production of coumestrol in pasture legumes, outbreaks of leaf fungal diseases should be minimised. Avoid closing up pastures for extended periods in spring because dense, ungrazed pastures provide ideal conditions for fungal diseases to develop. Insect damage, which can also stimulate coumestrol production, may also be greater under these conditions. The best grazing strategy to prevent pastures becoming too dense is set stocking in spring at moderate stocking rates.

Fungicide application for leaf diseases is not likely to be an economic option. Poor plant nutrition also stimulates coumestrol production, so ensure adequate fertiliser is provided to the pasture.

Further reading

The Farm Budget Guide. ‘Pasture Legume Recommendations’.

Bulletin 4133 ‘Fungal diseases of pasture legumes in Western Australia’

Bulletin 4327 ‘Registered cultivars of subterranean clover – their characteristics, origin and identification’

Anon. (2004). Pasture Legumes for Temperate Farming Systems – The Ute Guide, Top Crop Australia. pp. 147.

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