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CLOVER INFERTILITY OF SHEEP
— a continuing problem

By Norm Adams, Division of Animal Production, CSIRO, Wembley, and Keith Croker, Sheep and Wool Branch, Department of Agriculture

Some varieties of subterranean clover, notably Dinninup, Dvalganup and Yarloop, contain compounds which act like the female sex hormone oestrogen. These plant oestrogens, or “phyto-oestrogens”, interfere with the fertility of sheep and depress the percentage of lambs born (Figure 1).

In the 1960s, highly oestrogenic clover-dominant pastures were common in Western Australia, and severe signs of clover disease were often seen. Affected ewes showed prolapse of the uterus in spring, they had difficult births, and there were low lambing percentages in affected flocks. Wethers had enlarged bulbo-urethral glands.

Today oestrogenic clover dominant pastures are rare, and these spectacular signs of clover disease have disappeared. However, oestrogenic strains of clover are still widespread in the State, and many people suspect that they are still having a deleterious effect on reproduction.

Over the past 10 years our understanding of clover infertility has increased, and we can now gauge the extent of this residual problem. In fact, there is a widespread but low-level incidence of infertility which does not greatly affect individual farms but which has an important impact on the State’s sheep production.

Biology
Clover pastures are oestrogenic only while they are green, and sheep in Western Australia are usually mated on dry pasture, so phyto-oestrogens should not be a problem at mating. However, if the ewe is exposed to oestrogen for long periods her fertility can be permanently reduced. This happens because the ewe starts to change her sex and become male-like.

[Graph showing the percentage of lambs born in ewe flocks grazed on non-oestrogenic (oat) and highly oestrogenic (clover) pastures during the pasture growing season each year for eight years at Badgingarra.]
Table 1. The numbers of ewes mated and the percentages of lambs marked to actual matings reported by the Australian Bureau of Statistics for Western Australia during the years 1978 to 1987 (year ending March 31)

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<td>Ewes mated (million)</td>
<td>13.0</td>
<td>13.6</td>
<td>13.9</td>
<td>14.1</td>
<td>14.2</td>
<td>14.1</td>
<td>13.5</td>
<td>13.8</td>
<td>14.1</td>
<td>13.8</td>
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<tr>
<td>Lambs marked (%)</td>
<td>59</td>
<td>66</td>
<td>70</td>
<td>71</td>
<td>63</td>
<td>67</td>
<td>67</td>
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Directed migration of spermatozoa swimming in a strand of normal cervical mucus (left) compared with random orientation of sperm in mucus from a ewe with clover infertility (right).

During pregnancy in all species of animals the young foetus begins development as a non-sexual form, neither male nor female. In the absence of oestrogen, the foetus develops into a female. In the presence of oestrogen and other hormones secreted by the testis, the foetus develops as a male. Once the animal is born, oestrogen loses its ability to make animals become male-like. However, in the ewe, unlike all other species, this loss is not complete. Thus, if adult ewes are exposed to oestrogen for long enough, they start to lose their female characteristics and to become male-like. Strangely, plant oestrogens do not affect the foetus, probably because they do not cross the placenta effectively.

This trans-sexual change in affected ewes leads to slight male-like changes in the vulva; the clitoris may grow, and the lower lips of the vulva may fuse slightly to form a primordial sheath. There are also changes in hormone secretion and a slight increase in ram-like behaviour. These external signs are subtle, especially in comparison with the gross symptoms seen in the early days of clover disease. However, the most important abnormality is seen in the cervix, which almost disappears to be replaced by the uterus as the reproductive tract reverts to a foetal-like state.

The cervix plays an important role in sperm transport. As its function starts to be lost following the intake of phyto-oestrogens, the ewe needs to be inseminated more frequently to conceive. Thus, the main signs of the presence of a residual clover disease problem are an increase in the number of ewes returning to the ram, and an increased proportion of ewes which are served but fail to lamb.

Occurrence on farms
Although obvious clover disease is rare these days, most ewes in the Great Southern have some degree of defeminisation, or trans-sexual change. On average, more than 20 per cent of ewes in this area fail to lamb each year, and a recent survey by CSIRO indicated that much of this loss can be attributed to damage caused by plant oestrogens. In this survey, cast-for-age ewes were examined from seven farms in 1982 and 11 farms (including five from the previous year) in 1983. These farms were chosen from areas with a range of rainfalls from low (300 to 330 mm per year) to medium (530 to 590 mm) and their lambing histories varied from below to above the State average lamb marking percentage of about 70 per cent (See Table 1).

The ewes were slaughtered about eight weeks after rams were removed from the flocks after a six-week joining period. The number of ovulations on the ovaries and the number of foetuses present were counted. The number of
cysts on the uteri, which develop after ewes eat clover plants over a long period, were also recorded for an assessment of the effect of the pastures on the ewes. In addition, the microscopic structure of the cervix was measured on histological sections of the cervical tissues. This allowed an accurate measure of the changes induced by the clover oestrogens.

Although the oestrogenic damage found in the ewes was closely associated with the proportion of dry ewes in the flocks (Figure 2), the lambing percentages were not greatly depressed. This was because farms which had a high proportion of dry ewes because of clover infertility also had more ewes bearing twins. These two effects cancelled each other and the overall lamb marking percentages were similar regardless of the clover status.

Nevertheless, the study showed that clover oestrogens are an important reason for the relatively high proportion of ewes which fail to lamb in the south of Western Australia. While farmers with a dry ewe problem may be getting a satisfactory lamb marking rate because of twins, the efficiency of their sheep enterprise is less than it would be in the absence of plant oestrogens.

Overcoming the problem

Improved flock management

Flock management is the solution adopted by most farmers, sometimes perhaps unknowingly. By improving sheep management, such as improved nutrition of ewes before and during mating, and use of better paddocks at lambing, adequate lamb marking percentages are possible despite a high proportion of dry ewes.

The disadvantages of this approach are the extra costs of special management and restrictions on management options; and the farmer continues to ignore or to be unaware of the real problem.

Replace high-oestrogen clovers with low-oestrogen clovers

Special clover replacement programmes are usually not economically feasible because of the length of time that paddocks are out of production. However, there are many occasions when a paddock needs to be resown with clover, and at these times every effort should be made to use low-oestrogen varieties. The planting of an oestrogenic variety just because the seed is cheaper could prove to have later hidden costs.
Photomicrographs of cross-sections through the cervix. Compared with the normal ewe (right) the ewe exposed to oestrogen (below right) has fewer folds and a large area of uterine-like tissue containing glands underneath the folds.

Figure 3. The percentages of lambs born in resistant and control ewe flocks grazed on highly oestrogenic clover pasture for eight years at Badgingarra.

Introduce grasses to pastures

On most sheep properties, the aim of pasture management is to maintain a good proportion of subterranean clover. However, in clover-dominant pastures it may be worthwhile to sow rye grass to dilute the amount of oestrogenic clover eaten and also to provide some early winter feed. However, farmers should be aware of the problem of annual rye grass toxicity in some areas and must consider the implications of sowing rye grass.

Develop resistant ewes

Many farmers believe that they have improved the reproductive performance of their flocks by culling ewes which do not bear lambs. A recent study by the Department of Agriculture at Badgingarra Research Station endorses this view by showing that ewes can inherit resistance to the effects of oestrogenic pasture.

In this study rams were bred from ewes which had maintained their fertility after grazing highly oestrogenic pastures from three to seven years. These rams were then joined with unselected ewes and the production from the ewe progeny (resistant ewes) was compared with that from similar ewes born to ewes joined with unselected rams (control ewes). The ewes were examined over eight years, during which some grazed a highly oestrogenic clover pasture and others a non-oestrogenic oat pasture each growing season.

Figure 3 shows that the percentage of lambs born to the resistant ewes grazed on the clover pasture was higher than that for the control ewes grazed on the same pastures after the first three lambings. This suggests that the selected ewes have inherited a resistance to the effects of the clovers. The selection for maintenance of fertility on highly oestrogenic pastures may provide a means of reducing the clover infertility problem. However, the best way to use this technique is not yet clear.

Studies have shown that failure to lamb is not highly repeatable, so that ewes dry in one year are likely to lamb the next. Therefore if all dry ewes are culled, many “innocent” ewes will be sent off together with the ewes of lower genetic merit. Furthermore, the farms which most need this approach, the farms with many dry ewes, are those which are least able to apply it because they need all their ewes to produce enough lambs to maintain their flocks. For these farms, the use of resistant rams may be the most appropriate solution.