Reproductive wastage among Merino ewe flocks. 2. Non-clover areas

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This issue of Research Round-up contains two short reports of investigations in a series which sought to define the reasons for low fertility among Merino ewes in Western Australia, and preliminary results of two experiments which investigated a potential method of improving low ovulation rate—one of the major reasons for poor fertility.

Reproductive wastage among Merino ewe flocks

I—Clover areas

By R. H. Wroth and R. J. Lightfoot, Sheep and Wool Branch

Results from the first year of a planned three-year research programme on reproductive wastage among commercial sheep flocks grazing oestrogenic subterranean clover-based pastures in southwestern Australia were discussed in the June, 1972, issue of the Journal of Agriculture.*

The first two years of the project were aimed at defining the problems so that ways to overcome them could be evaluated in the third year. This report summarises the first two years’ results and discusses the major areas of reproductive wastage.

Methods

Ten properties in the Shires of Kojonup, Arthur River and Williams were involved in the project in 1971. Eight of these were examined again in 1972. In each case a minimum of 400 ewes were involved; 200 of these were four-tooth ewes being mated for the second time and the remainder were older ewes. The reason for this age split was to identify any decline in fertility with age that could be associated with clover disease.

The flocks were joined at the usual time for each property with the normal percentage of rams. During the six weeks of joining all ewes were run as one flock. All rams were fitted with sire-sire harnesses to identify the ewes served and to indicate the mating pattern of the flock. During the first 16 days of joining the ewes were examined four times to select ewes for surgery so that ovulation and egg fertilisation rates could be determined. This was essential to establish the potential of each flock and to calculate the subsequent losses due to embryo mortality (losses between fertilisation and lambing).

At lambing the ewes were split into two flocks, those that would lamb in the first 2½ weeks of lamb-
ing and those that would lamb later. This was done on the basis of individual mating records and a pre-lambing pregnancy diagnosis.

**Results and discussion**

One aim of the project was to identify variation in the type and magnitude of reproductive wastage between years and between properties. If such variation was large, interpretation of the results would become complicated. In most respects, however, the results were similar for the two successive years reported here.

1. **Mating pattern**

A lower proportion of ewes than expected was served in the first cycle (16 days) of joining (Table 1), indicating that many ewes were not coming into oestrus regularly. However, after four weeks of mating most ewes had been served at least once. Figure 1 shows the 19 per cent lag in the number of ewes served during the first cycle compared with the theoretical pattern of service. This graph, based on two years' data, gives a good representation of the overall situation because the variation between years was extremely small.

Ewes which are not served in the first cycle have fewer opportunities to conceive. If they fail to conceive at the first service many will not have the opportunity to return to service before joining ends.

2. **Ovulation rate**

The ovulation rate (the mean number of eggs shed per ewe) was consistently low in each year of the study (Table 1) but was higher among heavier ewes, especially in the older age groups. The low incidence of oestrus and the low ovulation rates many have a common cause, so if ovulation rates could be improved the incidence of oestrus in the first cycle might also be improved.

3. **Fertilisation rate**

Surgical examination showed that about 75 per cent of ewes served in the first cycle were fertilised. Fertilisation rates were similar in 1971 and 1972 (Table 2).

Two aspects of the fertilisation rate results deserve comment. In the first year (1971) there was a difference in the fertilisation rate in favour of the young ewes. This reflects the effects of clover disease in reducing the fertility of the older ewes in a flock. In 1972 the average age of the two groups of ewes was much closer, hence the similar fertilisation rates.

Secondly, other studies have shown that in areas where sheep do not graze oestrogenic pastures the fertilisation rate is commonly around 90 to 95 per cent. That is 15 to 20 per cent higher than rates reported here for ewes grazing oestrogenic sub. clover-based pastures. These findings therefore support previous evidence that even in young ewes (2½ years old at mating) fertility may already be affected by clover disease.

4. **Embryo mortality**

Although 75 per cent of the ewes served in the first cycle were fertilised, 30 per cent of these failed to produce a lamb from that service. That is, there was about a 30 per cent loss due to embryo mortality.

The results show that embryo mortality was extremely variable, ranging from 7 to 59 per cent (Table 2), but it still represented a considerable loss of potential lambs and so must further reduce reproductive efficiency.

At this stage, however, it appears to be an unavoidable loss, as little is known of the factors that contribute to the death of the embryo, or of ways of overcoming embryo losses under paddock conditions.

5. **Percentages of ewes lambing**

The percentage of ewes that lambed was generally low (Table 1). In the first year the young ewes were more fertile than the old ewes. However, in the second year higher fertility of the old group was probably due to the reduced average age of this group coupled with the fact that pastures in 1971 were generally grass-dominant, thereby reducing their oestrogenicity. Among the young ewes there was a noticeable increase in the percentage of ewes lambing as average liveweight increased; this effect has been widely reported from studies throughout Australia. However, among the old ewes percentage lambing decreased with increasing liveweight. This is an indication of the presence of old, clover-affected infertile ewes which had gained weight as a result of not having raised lambs in previous years.

**Conclusions**

This project has shown that the main causes of low fertility among Merino flocks grazing oestrogenic sub. clover-based pasture are:

- Low incidence of oestrus.
- Low ovulation rate.
- Low fertilisation rate.
- High embryo mortality.

As a result of these findings, further specific work is being conducted to attempt to overcome these problems.
Reproductive wastage among Merino ewe flocks

2—Non-clover areas

By T. Marshall, B. R. Beetson, R. J. Lightfoot and G. R. McMullen, Sheep and Wool Branch

While the effects of clover disease are in part responsible for Western Australia's low lamb-marking percentage, this is not the major State-wide cause as over half the state's ewes graze pastures which contain little or no oestrogenic clover.

In late 1970, a series of investigations was begun to define specific areas of reproductive wastage and to estimate their magnitude and variability among commercial sheep flocks grazing non-clover pastures in the eastern wheatbelt of Western Australia.

It was intended that the information obtained from these studies would be used to formulate remedial measures to improve sheep fertility.

The results in brief of the first year of the investigations have been published in a previous issue of the Journal of Agriculture.*

This report summarises and compares data from the first two years of the investigations (the definition phase) and highlights what appear to be the major causes of reproductive wastage in this environment.

**Methods**

In late 1970, seven ewe flocks which had not grazed subterranean clover were selected in the Merredin/Nungarin area. Five of these flocks were studied again in 1972. From each flock a minimum of 400 ewes, ideally half four-tooth ("young" ewes) and half old ewes, were individually ear-tagged and weighed.

The investigations were designed to interfere as little as possible with normal farm management practices such as flock joining time and ram percentages. However, all rams were fitted with sire-sine harnesses and crayons so that the mating behaviour of the flock could be monitored. Joining dates varied from early December to early March and rams were left with the ewes for six weeks on each property. All ewes were mated on cereal stubbles.

During joining a series of mating checks was carried out. At each mating check the tag numbers of those ewes which had been served by the ram were recorded. The crayon colour of the rams was changed after the first 16 days of joining so that ewes returning to service could be recorded.

The reproductive tracts of two samples of ewes drawn from those which were served by the rams in the first 16 days of joining were examined, using simple surgery techniques. This yielded estimates of ovulation rate (the number of eggs shed by the ovaries), egg fertilisation rate and sperm transport through the tract.

Following joining the ewes were run as one mob under normal conditions. At lambing time the ewes were pregnancy-diagnosed and split into two groups. The tag numbers of all ewes which lambed were recorded.

Because of the large numbers of ewes involved and the extensive conditions under which they were run, estimates of twinning rates and lamb mortality could not be obtained.

From the estimates of fertilisation rate and lambing rate the degree

**Table I—Ewes served for the first time by days 16 and 42 of joining and ewes lambing percentage in experimental flocks**

<table>
<thead>
<tr>
<th></th>
<th>Days 1-16</th>
<th>Days 1-42</th>
<th>Percent ewes served</th>
<th>Percent ewes lambing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young ewes</td>
<td>71</td>
<td>60-84</td>
<td>93</td>
<td>85-99</td>
</tr>
<tr>
<td>Old ewes</td>
<td>70</td>
<td>57-92</td>
<td>92</td>
<td>81-98</td>
</tr>
<tr>
<td>Both ages</td>
<td>70</td>
<td>57-90</td>
<td>92</td>
<td>82-98</td>
</tr>
<tr>
<td>1972—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young ewes</td>
<td>54</td>
<td>23-68</td>
<td>88</td>
<td>85-93</td>
</tr>
<tr>
<td>Old ewes</td>
<td>70</td>
<td>38-85</td>
<td>92</td>
<td>92-97</td>
</tr>
<tr>
<td>Both ages</td>
<td>60</td>
<td>38-78</td>
<td>90</td>
<td>92-97</td>
</tr>
</tbody>
</table>

**Table II—Ovulation, fertilisation and embryo mortality**

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Range</th>
<th>Average</th>
<th>Range</th>
<th>Average</th>
<th>Range</th>
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<tbody>
<tr>
<td>1971—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young ewes</td>
<td>1.06</td>
<td>1.00-1.35</td>
<td>94</td>
<td>92-100</td>
<td>23</td>
<td>16-42</td>
</tr>
<tr>
<td>Old ewes</td>
<td>1.09</td>
<td>1.00-1.30</td>
<td>92</td>
<td>79-100</td>
<td>17</td>
<td>6-35</td>
</tr>
<tr>
<td>Both ages</td>
<td>1.08</td>
<td>1.00-1.31</td>
<td>92</td>
<td>79-100</td>
<td>19</td>
<td>6-31</td>
</tr>
<tr>
<td>1972—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young ewes</td>
<td>1.00</td>
<td>1.00-1.00</td>
<td>93</td>
<td>89-100</td>
<td>35</td>
<td>29-44</td>
</tr>
<tr>
<td>Old ewes</td>
<td>1.11</td>
<td>1.00-1.22</td>
<td>92</td>
<td>89-100</td>
<td>27</td>
<td>18-39</td>
</tr>
<tr>
<td>Both ages</td>
<td>1.11</td>
<td>1.00-1.22</td>
<td>92</td>
<td>89-100</td>
<td>30</td>
<td>18-44</td>
</tr>
</tbody>
</table>

of embryo mortality (per cent ewes producing fertilised eggs which failed to produce lambs) was estimated.

Results and discussion
Because of the high repeatability of most of the results between properties, regardless of time of joining, the results from all properties were pooled for each year. They are summarised below.

1. Mating behaviour (incidence of oestrus)
In each year the number of ewes served by the rams in the first 16 days averaged only about 70 per cent. This was at least 20 per cent lower than that expected if all ewes had been cycling (coming into oestrus every 16-18 days). However, by the end of joining most ewes had been served by the ram (Table 1).

Closer examination of the data showed that most ewes were served by the end of the fourth week of joining. This suggests that many ewes were not cycling regularly at the start of joining, even when joining did not begin till February or later, but began cycling in the presence of rams. This apparent "teaser" effect further emphasises that the problem of failure of service was due to lack of oestrus in the ewes and not to poor ram libido.

The relatively low proportion of ewes cycling during the early part of joining represents a significant area of wastage. Ewes which are not served until late in the mating period have much less chance of returning to service should they fail to hold to their first service.

2. Ovulation rate
The ovulation rates recorded in these studies were surprisingly low (average 1.08-1.11) in both years (Table 2). On most properties the ovulation rate of the older ewes was higher than that of the young ewes and also tended to be higher in heavier ewes.

The ovulation rate sets the upper limit to the potential number of lambs which could be born. The low ovulation rates found in these studies supports the belief that this is the most important factor limiting sheep fertility in the agricultural areas.

3. Egg fertilisation
Egg fertilisation rates (Table 2) were high (average 92 per cent) in both years, although joining took place in hot wheatbelt conditions. High numbers of sperm were also found attached to fertilised eggs. These data suggest that ram fertility is not a problem in these environments.

While occasional cases of heat-induced infertility may occur among rams, flock fertility is not likely to be adversely affected provided two or more per cent rams and more than five rams in total are joined.

4. Embryo mortality
The overall levels of embryo mortality were high but varied widely between properties and years.

The causes of this loss or the reasons for the variation found are not known at this stage. However, a certain amount of embryo mortality is inherent and unavoidable.

Much more definitive work is required to determine ways of reducing embryo mortality under field conditions.

5. Lambing rate
Although about 90 per cent of the ewes lambed in 1971, the number of lambs born still would have been well below the potential of Merino ewes because of the low ovulation rates.

The relatively lower number of ewes lambing in the second year was probably a reflection of the poor season experienced in that year. This resulted in much higher than normal death rates among pregnant ewes.

Conclusions
There was very little variation between years in the estimates of most wastage parameters measured. This suggests that the estimates obtained are a reasonable reflection of the real situation in these non-clover environments.

From the data obtained the major factors limiting sheep reproductive rates in non-clover areas are failure of service due to lack of oestrus among ewes, and low ovulation rates.

Embryonic mortality also contributes significantly to the overall wastage, although its effect is variable between properties and between years.

Ram fertility does not appear to be a problem provided adequate numbers of rams are joined with the ewes.

Research in progress seeks to overcome the problems of lack of oestrus and low ovulation rate.

The effects of pasture type and lupin grain supplementation on ovulation rate of Merino ewes

I—Rate of lupin grain supplementation


Recent investigations of reproductive wastage among commercial sheep flocks in Western Australia have pointed to low ovulation rate as one of the major factors limiting flock lambing percentages.

The ovulation rate, or the number of eggs shed by the ovaries at each oestrus period, sets the upper limit to the potential number of lambs which may be born. If the average ovulation rate of a flock is 1.10 (the approximate average of all Merinos studied in the research mentioned above) then the most eggs that are available to be fertilized is 110 for each 100 ewes in this flock. But if the ovulation rate is 1.50 then 150 eggs could be fertilized for each 100 ewes, indicating the prime importance of ovulation rate in determining overall flock fertility.

There is a bulk of evidence from experiments conducted both in Aus-
level of supplementation
0 Control
0.0625 kg
0.125 kg
0.25 kg
0.5 kg

Figure 1—The effects of lupin grain supplementation on live weight of Merino ewes grazing dry subterranean clover pasture

Days on experimental pastures

Change in live weight (kg)

Figure 2—The effects of lupin grain supplementation on live weight of Merino ewes grazing wheat stubble

Days on experimental pastures

Change in live weight (kg)

Method
The treatments used are shown in Table 1. The experiment was conducted at Wongan Hills Research Station using mixed age Merino ewes and began in November, 1973.

Supplementary feeding with lupins began early in January, five weeks before joining was scheduled, and continued throughout the first 18 days of joining. The sheep were fed each Monday, Wednesday and Friday.

Following 14 days of "teasing" with 2 per cent vasectomised rams, joining began in mid-February with 4 per cent entire rams and mating checks were carried out at weekly intervals. The reproductive tracts of half of the total number of ewes served in each of the first three weeks were examined by laparotomy to determine ovulation rate.

Results and discussion
Body weight changes of the various groups are summarised in Figures 1 and 2. Ewes grazing sub. clover pastures, when supplemented with either 0.25 or 0.5 kg lupin per head per day, gained about 5 kg in live weight during the 53-day feeding period. The sub. clover ewes receiving lesser amounts of lupin gained correspondingly less weight. Only at the high levels of supplementation did ewes grazing wheat stubble increase in live weight and then the gains were only of the order of 1 to 1.5 kg. The other treatments on the wheat stubble all lost weight.

Ovulation rates (each estimate is based on about 25 ewes) are shown in Table 2.

Two main points emerge from the results. Firstly, ewes grazing sub. clover pastures had higher ovulation rates than those grazing at pasture, rarely increase ovulation rate. Attention was therefore focussed on feeds containing a higher level of protein. Lupin grain seemed promising as it can contain high levels of protein (about 35 per cent) and it is being grown in increasing quantities throughout south-western Australia.

This brief progress report describes an experiment designed to test, firstly, whether supplementary feeding of ewes with lupin grain can improve ovulation rate, and secondly, whether the nature of the response varies according to the pasture type on which the flock is grazed.
wheat stubble. Secondly, lupin grain supplements effectively increased ovulation rates, but only at the higher rates of feeding, 0.25 and 0.5 kg/head/day.

If substantiated by lambing records, these results could have considerable influence on the joining husbandry practised by W.A. flock owners. It is common in many areas with improved pastures to join ewes on stubbles, yet the results clearly show that stubbles can reduce ovulation rate below that which occurs if the ewes are left on dry sub. clover. On either pasture type the results indicate that supplementary feeding with sweet lupin grain at the rate of 0.5 kg/head/day can improve ovulation rate dramatically. Further, results of a concurrent experiment at the Badgingarra Research Station, reported in the article below, indicate that a duration of feeding considerably shorter than that used at Wongan Hills may produce equivalent responses.

The responses to lupin feeding in terms of increased numbers of lambs reared will probably be less than that indicated by ovulation rates here. This is because ewes with twin ovulations may suffer a higher level of embryonic mortality or foetal death than those with one ovulation. In addition, lamb mortality rates are higher among twin lambs than among singles. The importance of these effects will be known when the ewes in this experiment lamb in July. In the final event the results must be subjected to rigid economic analysis before their potential for application on the farm can be gauged.

References quoted in this report are listed at the end the report below.—Part 2 of this series.

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Table 1—Experimental design and number of ewes per treatment

<table>
<thead>
<tr>
<th>Level of supplement</th>
<th>No. of ewes/treatment set-stocked at 6·2 sheep/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>kg of sweet lupin grain/hd/day</td>
<td>Sub. clover pasture</td>
</tr>
<tr>
<td>Nil control</td>
<td>50</td>
</tr>
<tr>
<td>0·0625</td>
<td>50</td>
</tr>
<tr>
<td>0·125</td>
<td>50</td>
</tr>
<tr>
<td>0·25</td>
<td>50</td>
</tr>
<tr>
<td>0·5</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 2—Ovulation rates for ewes grazing either sub clover pasture or wheat stubble when supplemented with sweet lupin grain

<table>
<thead>
<tr>
<th>Level of lupin supplement (kg per head per day)</th>
<th>Pasture type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil control</td>
<td>1·25</td>
</tr>
<tr>
<td>0·0625</td>
<td>1·17</td>
</tr>
<tr>
<td>0·125</td>
<td>1·25</td>
</tr>
<tr>
<td>0·25</td>
<td>1·42</td>
</tr>
<tr>
<td>0·5</td>
<td>1·61</td>
</tr>
</tbody>
</table>

The effects of pasture type and lupin grain supplementation on ovulation rate of Merino ewes

2—Duration of lupin grain supplementation


In the reported experiment above encouraging results were obtained by feeding various levels of sweet lupin grain to ewes grazing either subterranean clover pastures or wheat stubbles. In that experiment ewes were fed for 35 days beforejoining and for 18 days thereafter.

The economic success of special feed supplements for any purpose depends on the total cost of feeding the supplement and the value of any resulting increases in productivity. An important factor in determining the total cost of a supplement is the period for which it has to be fed to achieve the desired response. This article briefly reports an experiment which examined the effects of grazing various base pastures supplemented by lupin grain or lucerne hay on the ovulation rate of Merino ewes.

Method

The treatments used in the experiment, which was conducted at the Badgingarra Research Station, are summarised in Table 1.

Seven weeks before joining was scheduled six groups, each of 99 mature Merino ewes, were randomly selected and eartagged. They were then run as one flock on sub. clover pastures for two weeks after which they were split into their respective treatment groups. Four groups were then placed on four equal areas of sub. clover pasture and one on oats stubble. The remaining group of ewes ran on sub. clover pasture for a further 10 days and was then placed on a freshly harvested lupin stubble. The stocking rate of all groups was about 12.3 sheep per hectare. The sub. clover groups were rotated between their plots at weekly intervals.

Immediately the ewes were placed on the experimental pastures (35 days before joining) sweet lupin supplements were given to one group of the sub. clover ewes at the rate of 0.5 kg per head per day. Another group of ewes grazing sub. clover was offered lucerne hay at the rate of 0.75 kg per head per day from this time. Similar supplements of lupins were given to a third group of ewes grazing sub.
clover, but starting 14 days before joining. The fourth group of sub. clover ewes received no supplements. All lupin and lucerne supplements were continued for 18 days after the start of joining.

Entire rams, at the rate of 4 per cent, were introduced to the flocks in mid-February. The ewes in this experiment were not teased before joining. Mating checks were carried out at weekly intervals and the ovaries of half the ewes served in each of the first three weeks were examined by laparotomy to determine ovulation rate. The ovulation rates obtained were based on samples of approximately 50 ewes per treatment. All ewes were weighed at regular intervals during the experiment.

Results and discussion

During the first three weeks on the experimental pastures all treatments lost weight. After this initial weight loss those ewes grazing lupin stubble began to gain weight and after 10½ weeks had gained 2.2 kg (Table 2). Ewes whose lupin supplementation began 14 or 35 days before joining gained 1.3 and 1.6 kg respectively, while those ewes supplemented with lucerne hay gained 0.7 kg by the end of the feeding period. After their initial weight loss the bodyweight of the ewes grazing sub. clover without supplements remained relatively steady. Ewes grazing oats stubble steadily lost weight and after 12 weeks had lost 5 kg.

Ovulation rates during the first three weeks of joining (Table 3) reflected these bodyweight changes. The ovulation rates of 1.09 and 1.24 recorded on the oats stubble and sub. clover pastures were similar to those found among ewes grazing wheat stubble and sub. clover in the concurrent experiment reported above. The low rates from the stubble treatment ewes were also similar to those found previously among commercial sheep flocks which were grazing cereal stubbles during joining. This suggests that low ovulation rates are characteristic of ewes grazing cereal stubbles at joining and that the grazing practices used at mating by many commercial producers who have areas of improved pasture may need review.

Where ewes grazing sub. clover pastures received supplements of lupins starting 14 or 35 days before joining the ovulation rates increased to 1.48 in both cases. Where ewes grazing sub. clover were supplemented with lucerne hay the ovulation rate rose to 1.38. The ovulation rate of ewes grazing the lupin stubble was 1.50. Lupin grain left on the ground after harvesting this plot was available to the sheep throughout the grazing period.

Similar ovulation rate responses were recorded for ewes in both 14 and 35-day lupin treatment, suggesting that the response may occur after a relatively short period of feeding. If the responses in ovulation rate are reflected in the number of lambs born, and these results will be known when the ewes lamb in July, methods of feeding lupin supplements around joining time may be developed which will lead to economic increases in ewe fertility.

References


Table 1—Treatments used in the experiment

<table>
<thead>
<tr>
<th>Base pasture</th>
<th>Supplement*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Oats stubble</td>
<td>Nil</td>
</tr>
<tr>
<td>2. Lupin stubble</td>
<td>Nil</td>
</tr>
<tr>
<td>3. Sub. clover pasture</td>
<td>Lupin grain 14 days prejoining</td>
</tr>
<tr>
<td>4. Sub. clover pasture</td>
<td>Lupin grain 35 days prejoining</td>
</tr>
<tr>
<td>5. Sub. clover pasture</td>
<td>Lucerne hay 35 days prejoining</td>
</tr>
<tr>
<td>6. Sub. clover pasture</td>
<td>Lucerne hay 35 days prejoining</td>
</tr>
</tbody>
</table>

* All supplements were continued for 18 days after the start of joining

Table 2—Live weight changes of experimental ewes

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Live weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 19, 1973 (On to experimental pastures)</td>
<td>March 12, 1974 (End of supplementation)</td>
</tr>
<tr>
<td>Oats stubble</td>
<td>47.4</td>
</tr>
<tr>
<td>Lupin stubble</td>
<td>45.5</td>
</tr>
<tr>
<td>Sub. clover</td>
<td>46.8</td>
</tr>
<tr>
<td>Sub. clover plus 14 days lupins</td>
<td>47.6</td>
</tr>
<tr>
<td>Sub. clover plus 35 days lupins</td>
<td>46.8</td>
</tr>
<tr>
<td>Sub. clover plus lucerne hay</td>
<td>46.7</td>
</tr>
</tbody>
</table>

Table 3—Ovulation rates of experimental ewes

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Ovulation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oats stubble</td>
<td>1.09</td>
</tr>
<tr>
<td>Lupin stubble</td>
<td>1.50</td>
</tr>
<tr>
<td>Sub. clover</td>
<td>1.24</td>
</tr>
<tr>
<td>Sub. clover plus 14 days lupins</td>
<td>1.48</td>
</tr>
<tr>
<td>Sub. clover plus 35 days lupins</td>
<td>1.48</td>
</tr>
<tr>
<td>Sub. clover plus lucerne hay</td>
<td>1.38</td>
</tr>
</tbody>
</table>