PRELIMINARY RESULTS ON SELECTION LINES FOR SPONTANEOUS SPRING OVULATORY ACTIVITY IN MERINOS D’ARLES SHEEP

J. Teyssier1, S. Canepa2, P. Chemineau2, B. Malpaux2, M. Migaud2 and L. Bodin3

1UMR Elevage des Ruminants en Régions Chaudes, INRA, 34060 Montpellier, France
2UMR Physiologie de la Reproduction et des Comportements, INRA, 37380 Nouzilly, France
3Station d’Amélioration Génétique des Animaux, INRA, 31326 Castanet-Tolosan, France

INTRODUCTION
A previous study of spring spontaneous ovulatory activity was realised during 3 consecutive years in the Merinos d’Arles (MA) ewes of the Domaine du Merle, (Hanoq et al., 1999). It showed that 30 % of the females were cycling in April before the mating period, and allowed to estimate repeatability (r = 0.30) and heritability (h² = 0.20) of this trait. Breeding values for spontaneous ovulatory activity of all animals involved in this trial have been estimated through an animal model which considered data of 933 ewes. Two extreme groups of ewes were selected on the basis of this breeding value and allowed to evidence an association between the genetic value for spring ovulatory activity and a mutation of the gene for melatonin receptor Mel1a (Pelletier et al., 2000). These extreme groups were also at the origin of divergent lines, which are being in process of creation since 1998. This paper presents preliminary results of the first generations of these selection lines.

MATERIALS AND METHODS
Management. As most breeds used in the Mediterranean areas, the MA is less seasonal than breeds from higher latitudes. This ability is fully exploited in Mediterranean and pastoral breeding systems in which the main mating period is spring. At the Domaine du Merle, South-Eastern France (43.5° N), MA ewes are mated once a year from mid-April to early June, before annual climbing to the Alpine pastures during the dry summer. Replacement ewes are mated for the first time, at the same period, when 18 months old. Ewes of the cyclicity trial are systematically weighed before being bled twice, 8-10 days apart during the first 2 weeks of April. They are synchronized by a progestagen treatment (+ PMSG until 1999) and joined with rams during three days on average. They lamb in autumn, just after coming back from the mountains and are dried up before mid-January. Shearing-time is in March.

Cyclicity measurement. The spontaneous ovulatory activity of ewes is determined by the level of progesterone in two blood samples collected before any reproductive event (synchronisation and/or ram introduction). Ewes with at least one sample with more than 1ng/ml of progesterone (determined by radioimmunoassay ; Terqui and Thimonier, 1974) are considered in ovulatory activity.

Selection process. In 1997, genetic values were estimated from data (1 = cyclic ; 0 = noncyclic) of 933 MA ewes collected between 1995 and 1997, through a BLUP animal model. This model considered the 'physiological status' (combining age and number of lambing) and
the live weight before mating as fixed effects; a random effect of animals and a random effect associated to the ewes to take into account repeated records. Two groups of ewes (and rams) were chosen as extremes of the overall genetic value distribution (generation G0). This included 101 ewes frequently cycling in spring (group H) and 100 ewes that rarely cycled in spring (group L). These G0 ewes were mated with 5 G0 rams from the same selection group to produce females and males of the following generation (G1). The first G1 and G2 (G1xG1) animals were respectively born in 1998 and 2000. The G1 females were collected for the first time in April 2000. The creation of the H and L lines is based on breeding values estimated under a mere polygenic inheritance hypothesis. It does not take into account of the genotyping for the Mel1a receptor gene.

In spring 2000, a control group of ewes from the MA flock (n = 38) was also bled and involved in the comparative study of the G1 ewes from selection lines.

RESULTS AND DISCUSSION

The number of ewes studied in April 2001 is given in table 1. Since 1997, the number of G0 ewes has decreased for general aging reasons. These ewes were 3-9 years old in 1998 and 6-10 years old in 2001.

Table 1. Number of ewes of the selection lines and control group in April 2001

<table>
<thead>
<tr>
<th>Generation</th>
<th>Birth year</th>
<th>H Line</th>
<th>L Line</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>G0</td>
<td>1991-1995</td>
<td>44</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>G1</td>
<td>1998</td>
<td>32</td>
<td>23</td>
<td>34</td>
</tr>
<tr>
<td>G1</td>
<td>1999</td>
<td>28</td>
<td>16</td>
<td>17</td>
</tr>
</tbody>
</table>

In the same flock, repeated controls of the spontaneous ovulatory activity, from January to April (unpublished results), showed that the cyclicity observed at the beginning of April would rather correspond to the end of the annual breeding season. The variations of spring spontaneous cyclicity of the G0 MA ewes, from 1997 through 2001, are described in figure 1. The substantial variations between years express the effects of environmental factors and confirm the age effect which has been previously evidenced by Hanoq et al. (1999) on the same flock. The performances reported in 1997 were used to establish the genetic values at the origin of the selection of G0 ewes, and naturally widely differ between groups. On average, over the 1998-2001 period, the genetic groups present a large and significant difference: 79.6% of ewes of the H group presented spontaneous ovulatory activity against 42.2% for the L group. Moreover for each year, the percentage of ewes with ovulatory activity in early spring was always higher for H than for L ewes (P < 0.0001) with a positive difference ranging from 32.3% (1998) to 47.1% (2001). Such results confirm the repeatability of this trait.

The mean live weights through the successive years, from 1997 to 2001, were 49, 53, 51, 49 and 50 kg respectively for H ewe; 49, 52, 52, 48 and 50 kg respectively for L ewes. They did not differ between H and L groups whatever year. No evident association was observed between these variations of live weight and the ovulatory activity.
Figure 1. Spontaneous cyclicity in early spring of the MA ewes from G0 generation of the selection lines H and L, from 1997 to 2001

Figure 2. Spontaneous cyclicity in early spring of the MA ewes from G1 generation of the selection lines H and L and control group, from 2000 to 2001

The first results for the G1 ewes, from 2000 to 2001, are described in figure 2. The young G1 ewes presented on both years a lower percentage of spontaneous ovulatory activity than the G0 adult ewes. However, over this period, a difference ($P < 0.01$) between lines were still observed: 40.7% and 24.6% in 2000 and 2001, respectively. Divergent selection realised on the G0 generation has clearly succeeded by making this difference. Moreover, the control
group presented an intermediate situation which shows that divergent selection has operated in both directions. Another approach of the out of season breeding ability has been successfully undertaken for a composite line of breeds through a direct selection on fertility after spring mating (Notter et al., 1998). Nevertheless, in this case, the selection criterion did not allow to separate the ewes that were spontaneously ovulating from those responding to the ’ram effect’ or those which are stimulated by the presence of cycling ewes. In our divergent lines, preliminary results on fertility at the controlled mating show a difference between the H and L group of G0 ewes: 66% vs. 60% in 1998 and 72% vs. 64% in 1999, after a progestagen + PMSG treatment, and confirm the relationship between the proportion of spontaneously cycling ewes before joining and the fertility over the whole mating period in spring (Kahldi, 1984). This between lines difference is also expected in the G1 generation.

Our results confirm the possibility and efficiency of a selection for spontaneous spring ovulatory activity in the MA breed. However, the selection line process must be continued in order to increase the divergence, to calculate the realised heritability and to evaluate with accuracy the response on fertility in spring.

ACKNOWLEDGEMENTS
Thanks to the staff in charge of the flock at the Domaine du Merle, especially F. Fosseries, D. Montier, C. Maton and its manager P.M. Bouquet, to N. Debus, R. Dumas, J.L. Gaubert and J. Gouy from the UMR for their contribution to blood sampling and the INRA RIA laboratory in Nouzilly for performing the progesterone assays.

REFERENCES