Synchronisation and artificial insemination of ewes—techniques which have possible commercial application

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ABSTRACT

A number of facets of artificial insemination in sheep were studied at Rotomahana Research Station. The trial was a 2^3 factorial comparing time of insemination (fixed-time, at oestrus detection), number of inseminations (single, double) and type of diluent (skim milk, caprogen; NZDB) involving 291 ewes synchronised with internal drug-releasing dispensers (CIDR, without PMSG). There were no significant differences between treatments. The results indicate that a conception rate of approximately 70% can be achieved using these techniques, which should have direct commercial application.

Keywords Sheep; AI; synchronisation; semen

INTRODUCTION

The number of centres offering a commercial artificial insemination (AI) service with sheep is increasing around the world. The majority of these AI programmes are based on fixed-time insemination (on-time AI) with ewes being synchronised using progestagen-impregnated vaginal sponges plus PMSG (Briois, 1980; M. L. C., 1982).

Satisfactory results have been obtained from 'on-time' insemination (Smith *et al.*, 1981 a, b; Langford *et al.*, 1982) and the technique has the advantage of allowing detailed pre-planning for full utilisation of personnel, rams and facilities. However, the number of spermatazoa required for good fertilisation to a progestagen-induced oestrus is high, 200 to 400×10^6 (Langford and Marcus, 1982), with the majority of programmes using 400×10^6 sperm per dose (Briois, 1980; M. L. C., 1982; Langford, 1982). Another major fact influencing the use of 'on-time' AI is the cost of PMSG which has been deemed essential at the time of sponge removal (Langford, 1982). Rotomahana Research Station has been involved in AI for 4 years as part of routine single-sire mating (Meyer and Harvey, 1981), recently using controlled internal drug releasing (CIDR) devices without PMSG for synchronisation of ewes.

EXPERIMENTAL DESIGN

A total of 291 ewes, born 1979 and 1980, were used in the AI trial in 1983. A 2^3 factorial design was used, the treatments being time of insemination, number of inseminations and type of diluent as detailed below.

(1) **Time of Insemination:** Ewes were either inseminated 51 to 53 h after CIDR removal ('on-time'), irrespective of whether or not they showed oestrus, or inseminated only when oestrus was detected ('on-oestrus'). After CIDR removal all ewes were run with 6% of harnessed vasectomised rams and checked for oestrus activity, at up to 48 h for the 'on-time' group and at 24 h intervals until the end of the trial for the 'on-oestrus' group.

(2) **Number of Inseminations:** Single insemination versus double was compared. The first (or only) insemination was carried out at approximately 10.00 h daily, the second insemination for half of the ewes followed approximately 5 h later with diluted semen held over from the morning's collection.

(3) **Type of Diluent:** Two diluents were compared, heat-treated skim milk versus caprogen (NZDB egg yolk diluent). Each ejaculate (or pooled ejaculates) was split, half diluted with skim milk and half with caprogen diluent.

METHODS

All ewes were run together with 2% of vasectomised Poll Dorset rams for 6 weeks pre-mating and synchronised with CIDR dispensers, so as to spread the onset of oestrus equally over a 5-day period. Ewes were pre-allocated at random to 14 single-sire mating groups. Rams were trained to mount teaser ewes and semen was collected using an artificial vagina. All 14 rams were collected daily at 08.00 to 10.00 h and depending on the size of the ejaculate, rams were collected 1 to 3 times over this period of time. The semen was examined under a microscope and rated for motility and density. There was much variation in quality and quantity of semen produced, but because of the requirement for pre-determined single-sire mating, semen was used even when motility and density were relatively low.

A primary dilution (1 part semen to 2 parts diluent) was carried out with diluent at 32°C. After primary dilution, semen was cooled to room temperature (8 to 12°C). Semen concentration was determined using a spectrophotometer and a secondary dilution was carried out to standardise diluted semen to 800×10^6 sperm/ml. A dose rate of 0.25 ml. (200×10^6 sperm) of diluted semen was used per insemination between 1 and 4 h after collection for the first (or single insemination) and at 6 to 9 h for the second insemination.

Three groups of ewes were mustered daily (07.00 to 09.00 h); those ewes with CIDR to be removed and the 'on-time' and 'on-oestrus' groups to be inseminated. Ewes were inseminated using a raised race and a tilting swivel clamp, with semen being deposited at the first fold of the cervix using a lighted speculum and a glass pipette.

After insemination ewes were paddocked and reintroduced to vasectomised rams at approximately 48 h, until the end of the full Rotomahana AI programme (i.e., at 42 d). Ewes showing oestrus were reinseminated. Full pedigree records were collected at lambing as part of the normal data recording, giving date of birth and number of lambs born for each ewe in the trial. Ewes lambing up to 153 d after the synchronised oestrus of insemination were accredited to lambing to that insemination.

As well as the treatment effects, sire mating group, day of CIDR removal (1 to 5) and age of ewe (4- or 6-tooth) were included in the analysis of percent ewes lambing (% EL/EP) and percent ewes lambing multiples (% ELM/EL), with the logit transformation for binomial data being used.

RESULTS

The CIDRs provided an effective and concentrated synchronisation of the ewes. Only 2.2% of ewes in the 'on-oestrus' group did not show oestrus over the period of the trial. Fourteen (9%) ewes in the 'on-time' group did not show oestrus over the 48 h period between CIDR removal and insemination; however 7 of these ewes conceived to the 'on-time' AI. Fourteen CIDR were lost (4.8%), 2 ewes were unable to have CIDR inserted, 3 'on-oestrus' ewes did not cycle and 5 ewes died/missing pre-lambing. The latter 24 ewes were excluded from the analysis.

There was no significant effect of any of the factors considered on % EL/EP or % ELM/EL, the overall averages being 72% and 57% respectively. This is similar to a conception rate of 71% recorded for natural matings to a synchronised heat (Langford, 1982). The treatment estimates given in Table 1 are derived from a model fitting all main effects.

For % EL/EP and % ELM/EL, the treatment comparisons were respectively, 'on-oestrus' *v* 'on-time' insemination 6% and −3%, double *v* single insemination 6% and 3%, and caprogen *v* milk diluent 4% and −5%.

TABLE 1 Estimates for percent ewes lambing and percent ewes lambing multiples.

	% EL/EP		% ELM/EL	
	Estimate	Logit† value	Estimate	Logit value
Time of insemination				
on-time	69	0.80	58	0.32
on-oestrus	75	1.10	55	0.19
Single/double insemination				
single	69	0.80	55	0.19
double	75	1.10	58	0.32
Diluent				
milk	70	0.85	59	0.37
caprogen	74	1.05	54	0.15
Average	72		57	

Approximate logit s.e.d. = 0.31 % EL/EP, 0.37 % ELM/EL
† $\log_e p/(1-p)$ where p is the proportion of ewes lambing.

DISCUSSION

Although statistically not significant, these results indicate that a better conception rate may be achieved with 'on-oestrus' and double insemination; nevertheless, there are obvious advantages to 'on-time' and single insemination allowing for more efficient use of semen and labour.

Body weight and ewe condition may have an effect on the pattern of synchronisation of oestrus when using CIDR without PMSG. In 1983 at Rotomahana, with good conditioned ewes, CIDR provided very satisfactory results, however there may be justification for double insemination early in the breeding season or if ewes are low in condition.

The majority of overseas AI programmes use some form of synchronisation and many now use 'on-time' insemination using a vaginal sponge and PMSG programme. CIDR may provide an effective and cheaper alternative. It is considered that AI does have a place within the New Zealand sheep industry, mainly within group breeding schemes and recorded flocks, allowing them to use superior rams more effectively and provide reference sires for comparison between flocks.

If conception rates of approximately 70% can be achieved by the industry then the methods used at Rotomahana should have some direct commercial application.

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