ALTERNATIVE METHODS FOR SYNCHRONISATION OF EWES IN SPRING USING THE 'RAM EFFECT'

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The upswing in interest in controlled breeding of sheep has emphasised the need for techniques for synchronisation of oestrus and which increase ovulation rate. Progestagen-impregnated intravaginal sponges and Pregnant Mare Serum Gonadotrophin (PMSG) have an established role for these purposes in Australia and overseas, but their combined cost has limited their widespread applicability.

Spring is the season when the ovaries of most ewes are inactive but ovulation can be stimulated by the 'ram effect' or injection of PMSG (Oldham 1980). However ewes do not display oestrus when induced to ovulate by these techniques and the corpora lutea (CL) which subsequently develop are frequently abnormal unless the ewe has been primed beforehand by progesterone (Oldham et al. 1980). In the breeding season progesterone from the preceding cycle fulfils this priming role. In spring there are two strategies to provide the necessary priming with progesterone.

The 'ram effect' may stimulate a high proportion of anovular ewes to ovulate within three days and increase ovulation rate (Cognie et al. 1980). These ovulations result in CL which may provide progesterone to prime the ewe to display oestrus coincident with the next ovulation about 16 days later. But as many as 50% of stimulated CL are abnormal and regress within six days (Oldham and Martin 1978). If an abnormal CL precedes a normal CL it gives a peak of oestrous behaviour- around day 24 after introduction of the rams. Recent work has shown that a single injection of progesterone before the introduction of rams eliminates abnormal CL and oestrus is synchronised around day 19 (Cognie et al. 1982). The first paper in the contract describes some of the variables encountered when this method was used to synchronise oestrus under commercial conditions.

Progesterone priming can also be provided by the insertion of intravaginal sponges impregnated with synthetic progestagens. Withdrawal after a priming phase will not only facilitate normal CL function if ovulation is stimulated by the 'ram effect' or PMSG, but will ensure that the ewes display oestrus. As both the 'ram effect' and PMSG have been shown to increase the ovulation rate of ewes, conception at this ovulation may produce more lambs than at subsequent ovulations. However Cognie et al. (1980) reported that in some of their experiments progestagen priming apparently caused a decreased ovulation rate. With this in mind researchers in Victoria shortened the duration of progestagen priming in experiments aimed at inducing reliable breeding of crossbred ewes in spring using the 'ram effect' alone (Reeve and Charnley 1982). Their most recent results using this new approach to synchronisation are reported in the second paper.

The third paper in this contract reports a series of experiments using Merino ewes. The underlying hypothesis in experiments 1 - 3 was that by manipulating the 'ram effect' it could be used to replace PMSG as both an inducer of ovulation and stimulator of ovulation rate in programmes aimed at fixed time artificial insemination of ewes in spring.

A variable proportion of ewes does not reovulate and therefore does not display oestrus after the ram-induced ovulation (Oldham and Cognie 1980; Lindsay et al 1984). A fourth experiment tested the hypothesis that the 'ram effect' alone or in combination with PMSG could be used to synchronise ewes which are non-pregnant but which fail to reovulate.

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1 THE SINGLE INJECTION OF PROGESTERONE

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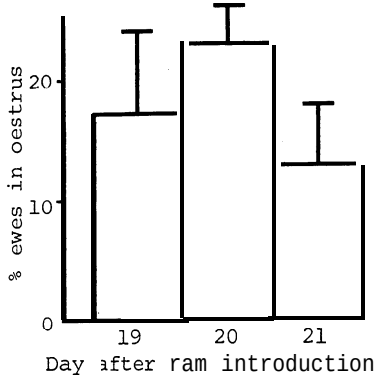
In each experiment the ewes were isolated from rams for at least one month. The 'ram effect' was evoked by at least 6% testosterone-treated wethers (TW) (Fulkerson et al. 1981) fitted with Sire-sine harnesses and used to detect oestrus. The day of the injection of progesterone was designated day 0. The ovarian activity of ewes was examined by laparoscopy (Oldham et al. 1976).

EXPERIMENTAL

Experiment 1

The practicality of using a single injection of progesterone was assessed during an AI programme conducted on seven properties between 8th October and 17th December 1981.



Immediately prior to the introduction of TW 20 mg of progesterone in 2 ml oil was injected intramuscularly (day 0). Oestrous ewes were drafted from the flock, twice daily, beginning on the afternoon of day 18 and continuing until the morning of day 21. A total of 9,649 ewes were treated and over the 3 days of drafting a mean (±SEM) of 55±7% of ewes were detected in oestrus (Fig. 1).

Figure 1. The mean percent of ewes injected with progesterone, detected in oestrus between day 18 (pm) and day 21 (am).

Experiment 2

A low proportion of ewes detected in oestrus between days 18 and 21 could result from three causes: 1) a low proportion of anovular ewes and hence few ewes available to be synchronised; 2) a poor response to the 'ram effect' among anovular ewes; 3) a good response among anovular ewes but failure of many ewes to reovulate with oestrus around day 19. The relative contributions of these 3 sources of failure were investigated in an experiment in which the ovarian activity of 196 ewes was observed before (day 0) and after (day 5) the TW were introduced. On day 0, 74 (38%) of the 196 ewes were ovulating spontaneously with an ovulation rate of 1.30. On day 5, 116 of the remaining ewes (95%) ovulated with a higher ovulation rate of 1.60 ($P < 0.01$). Between day 16 and day 26 only 63 of these 116 ewes (54%) were detected in oestrus. The ovaries of the 53 flockmates who were not marked by the TW were observed on day 29. Seventy percent (37/53) of the ewes were anovular. Hence in this experiment a good response among anovular ewes to the 'ram effect' was followed by a cessation of ovarian activity in many ewes, and a low proportion of the flock being detected in oestrus.

Experiment 3

In spring 1982 an experiment was conducted to determine the effect of vary-

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ing the timing of the injection of progesterone relative to the introduction of TW. On three farms progesterone (20 mg in 2 ml oil) was injected intramuscularly either 48 hours (n=296), 24 hours (n=297) or immediately prior to the introduction of TW (0 h, n=1031, day 0). On 2 of the 3 farms a 4th treatment, the injection of oil only at 0 h was tested (n=200).

Twice daily drafting of oestrous ewes began on day 16 and continued until day 21 for progesterone-treated ewes and until day 26 for those ewes treated with oil only.

The number of ewes displaying oestrus did not vary with time of injection of progesterone (-48 h, 81%; -24 h, 82%; 0 h, 83%), but did vary among the 3 farms (89%, 85% and 65%). Figure 2 illustrates how the peak of synchrony of oestrus moved progressively from around day 18 when progesterone was injected at -48 h, towards days 19 and 20 when progesterone was injected immediately prior to the introduction of TW (Fig. 2).

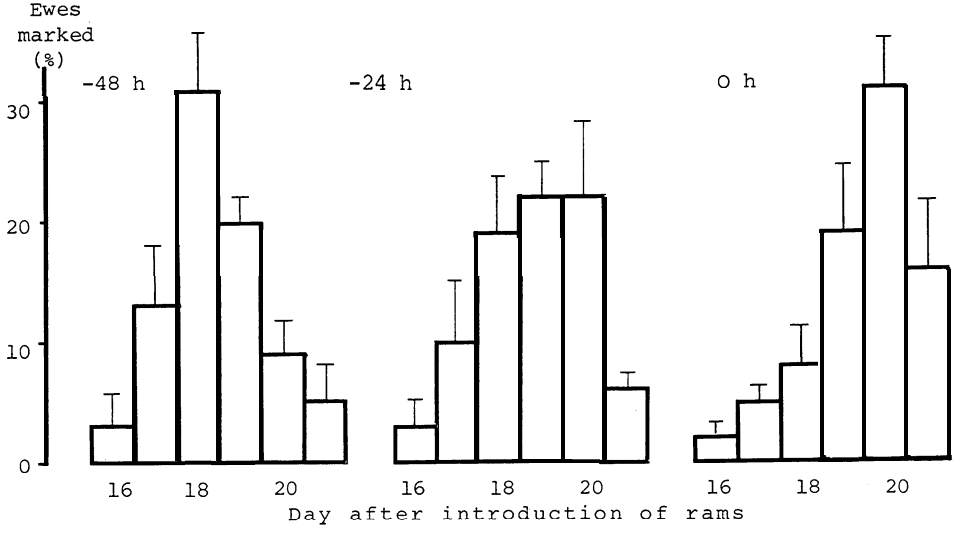

Figure 2. Effect of time of injection of progesterone on the synchrony of oestrus.

The single injection of progesterone resulted in no more ewes displaying oestrus than did an injection of oil (96 vs 89 and 65 vs 65 on 2 farms) but the ewes were detected over only 6 days compared with 11 days for ewes injected with oil.

CONCLUSIONS

A single injection of progesterone did not have any effect on the proportion of ewes responding to the 'ram effect' but simply ensured that they displayed oestrus in a single peak between days 16-21 after the TW were introduced. The injection of progesterone may precede the introduction of rams by as much as 48 hours without affecting the numbers of ewes responding but the pattern of synchrony will be altered. The number of ewes that displayed oestrus in response to the "ram effect' did vary between farms.

A low proportion of ewes detected in oestrus 16 to 26 days after introduc-

ing TW was not due to a poor ovulatory response among anovular ewes but rather to the fact that, amongst ewes responding many failed to reovulate and display oestrus around day 18.

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2 SHORT TERM USE OF INTRAVAGINAL SPONGES

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In northern Victoria there are approximately 5 million Border Leicester x Merino (BL x M) ewes which are traditionally joined to Poll Dorset rams for prime lamb production. A major obstacle to producers achieving reliable spring joining has been the between-year and between-flock variation in ewes showing oestrus at or shortly after joining. During the period between the southern vernal equinox and summer solstice, the number of ova shed per ewe ovulating is declining (Rizzoli et al. 1976) while the proportion of ewes responding to the 'ram effect' is increasing (Reeve and Chamley 1983). With this situation, selection of the most appropriate day for joining can be critical since early lamb production will depend upon the proportion of ewes which do respond to the 'ram effect' and their ovulation rate at the time of this response.

Using a management practice which exploits the 'ram effect' and employs short term insertion of a progestagen sponge, the interval between joining and conception can be reduced by.17 or 23 days (Reeve and Chamley 1982). Lambing concentrated into batches spaced at intervals of approximately 2 weeks and with each batch delivered during an interval of 4 - 5 days, offers advantages to the producer in terms of ewe and lamb management and lamb marketing.

The costs of short term use of intravaginal sponges in association with the 'ram effect' could be reduced by eliminating the requirement to treat every ewe with a sponge. Therefore experiments 1 and 2 were designed to determine whether the presence of large numbers of ewes in oestrus and a concentrated period of mating activity would influence oestrous behaviour in non-progestagen-treated (unprimed) ewes which had been exposed to the 'ram effect' 2-3 days earlier. In a third experiment it was hypothesised that short term use of intravaginal sponges and the 'ram effect' could be made more efficient by using PMSG to further increase fecundity.

METHODS

The ewes were allocated at random to groups of approximately 70 from a flock of 900 mature BL x M ewes after stratification according to past lambing date. All experiments were carried out at Rutherglen Research Institute with groups of ewes being isolated from rams for a 2 month period before the date of joining. Progestagen sponges (Repromap- mg) were inserted into all treated ewes for a period of 6 days and withdrawn on the day of joining. Ewes were joined to 8% of Poll Dorset rams fitted with Sire-sine harnesses. Mating and lambing data were recorded daily in each experiment.

Experiment 1

At joining progestagen primed (Control) and unprimed ewes were mated as one flock. On the same day a second unprimed flock was joined in isolation+ from the first flock, in isolation from oestrous ewes. The experiment was replicated in mid October and mid November. Results are presented in Table 1 where observations have been grouped into time intervals according to expected peaks of mating activity (Oldham 1980).

+ (sight, sound, smell)

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Control ewes showed mating and lambing patterns as described previously (Reeve and Chamley 1982). Greater numbers of unprimed ewes in flock 1 mated earlier in the post-joining period compared with unprimed ewes in flock 2 when joining occurred in October ($P < 0.001$). When compared with the isolated flock-mates the unprimed ewes run with primed ewes had 6 more ewes mated, 10 more ewes lambing, and an additional 19 lambs were born per 100 ewes joined.

TABLE 1 Mating and lambing data per 100 ewes joined

Date joined	Treatment		Period post joining (days) 0-3	4-20	21-26	27-37	38-43	Total	Mean lambing date
16/10/81	+MAP[5]	EM[1]	57	35		1		93	
		ER[2]		17		8			20/3/82
		EL[3]	39	41		6		86	
		L/E[4]	1.43	1.05		1.00		1.21	
Flock 1	-MAP	EM		20	59	11	4	94	
		ER					5		3/4/82
		EL		20	54	10	7	91	
		L/E		1.70	1.09	1.0	1.0	1.21	
Flock 2	-MAP (isolated)	EM	1	12	28	28	19	88	
		ER				6	5		10/4/82
		EL	1	6	23	31	14	81	
		L/E	1.00	1.25	1.22	1.09	1.00	1.13	
16/11/81	+MAP	EM	86	10				96	
		ER		23		3			17/4/82
		EL	63	30		3		96	
		L/E	1.33	1.13		1.00		1.26	
Flock 1	-MAP	EM	1	24	70	2		97	
		ER					5		
		EL	1	24	65	2	2	94	6/5/82
		L/E	1.00	1.04	1.09	1.00	1.00	1.08	
Flock 2	-MAP (Isolated)	EM	1	32	54	8		97	
		ER				5	2		5/5/82
		EL	1	27	52	11	2	96	
		L/E	1.00	1.11	1.00	1.08	1.00	1.11	

1. ewes mated; 2. ewes returning to service; 3. ewes lambing; 4. lambs born/EL; 5. Medroxy progesterone acetate intravaginal sponge (60mg, Upjohn)

Experiment 2

The rationale for this experiment was the same as for Experiment 1 but investigated joining at different dates only in October. The results are presented in Table 2. In this experiment differences in the occurrence of oestrus and the mating pattern between the two unprimed groups were apparent for both joining dates ($P < 0.001$). These differences were greatest for ewes joined early in October.

It is apparent that oestrous activity in these unprimed ewes can be influenced by the presence of oestrous ewes, with the influence being strongest

when the joining date was closest to the vernal equinox.

TABLE 2 Mating and lambing data per 100 ewes joined

Date joined	Treatment		Period post joining (days) 0–3	4–20	21–26	27–37	38–43	Total	Mean lambing date
4/10/82 Flock 1	+MAP[5]	EM[1]	87	6				93	
		ER[2]		10		3			
		EL[3]	74	13		0		87	5/3/83
		L/E[4]	1.22	1.00				1.18	
	-MAP	EM		33	47		6	86	
		ER				2	1		
		EL		30	43		7	80	27/3/83
		L/E		1.20	1.16		1.25	1.17	
Flock 2	-MAP (Isolated)	EM		9	22	8	19	61	
		ER				1	2		
		EL		8	21	9	20	58	2/4/83
		L/E		1.13	1.14	1.00	1.00	1.07	
25/10/82 Flock 1	+MAP	EM	88	9				99	
		ER							
		EL	69	25				94	29/3/83
		L/E	1.22	1.13				1.18	
	-MAP	EM		41	54			95	
		ER					4		
		EL		39	48		3	90	14/4/83
		L/E		1.15	1.13		1.00	1.14	
Flock 2	-MAP (Isolated)	EM		31	39	13	8	91	
		ER					6		
		EL		29	29	11	11	80	18/4/83
		L/E		1.11	1.11	1.10	1.14	1.14	

1. ewes marked; 2, ewes returning to service; 3. ewes lambing; 4. lambs born/EL; 5. Medroxy progesterone acetate intravaginal sponge (60 mg, Upjohn)

Experiment 3

The responses of progestagen-treated ewes which received zero, 400 iu or 600 iu PMSG i.m. on the day of sponge removal were compared. The results are shown in Table 3.

Ewes lambing to the ram-induced oestrus and ovulation was higher in those ewes which received PMSG ($P < 0.05$). Fecundity (L/E) was increased by the administration of PMSG ($P < 0.05$) but there was no further increase as the dose of PMSG was increased from 400 to 600 iu.

TABLE 3. Mating and lambing data per 100 progestagen-treated ewes joined on 16/11/81

Dose of PMSG		Period post joining (days) 0-3	4-20	21-37	Total	Mean lambing date
Zero	EM[1]	86	10		96	
	ER[2]		23	3		17/4/82
	EL[3]	63	30	3	96	
	L/E	1.34	1.13	1.00	1.26	
400 iu	EM	82	13		95	
	ER		10	2		10/4/82
	EL	72	22		94	
	L/E	1.50	1.23		1.44	
600 iu	EM	82	17		99	
	ER		3	3		13/4/82
	EL	66	25	2	93	
	L/E	1.53	1.20	1.00	1.43	

1. ewes mating; 2. ewes returning to service; 3. ewes lambing; 4. lambs born/EL.

CONCLUSION

After the vernal equinox insertion of progestagen sponges into anoestrous BL x M ewes for a period of 6 days before they are exposed to the 'ram effect' advances the mating pattern. With oestrus occurring on average 3 weeks earlier fecundity can often be increased because conception is occurring at a time when ovulation rate is higher.

It may be possible to increase the profitability of a management practice which exploits short term use of progestagen sponges in association with the 'ram effect' by (1) selection of the most appropriate joining date, (2) joining progestagen-primed and unprimed ewes as one flock, (3) administration of PMSG on the day of sponge removal.

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3 THE USE OF INTRAVAGINAL SPONGES AND PMSG

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The 'ram effect' is an alternative method to PMSG to stimulate ovulation and ovulation rate in commercial synchronisation programmes. The fertility of synchronised ewes, in France, was increased if rams were introduced to ewes two days before withdrawal of intravaginal sponges compared with flockmates given PMSG and introduced to rams coincident with sponge withdrawal (Y. Cognie pers. corn.). We have tested the feasibility of using the 'ram effect' to replace PMSG in three experiments between 1980-1982.

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A variable proportion of ewes do not display oestrus and reovulate after the ram-induced ovulation (Oldham and Cognie 1980; Lindsay et al. 1984). The fourth experiment tested the hypothesis that the 'ram effect' alone or in combination with PMSG could be used to synchronise ewes which fail to reovulate.

METHODS

The 'ram effect' was evoked either by the use of vasectomised rams or by testosterone-treated wethers (TW) (Fulkerson et al. 1981). These animals were fitted with Sire-sine harnesses and used to detect oestrus. Ewes were artificially inseminated 12 hours after detection of oestrus. In experiments l-3 the ewes were isolated from rams for at least one month and intravaginal sponges were inserted for 12 days. Oestrus was checked every 12 hours for 90 hours after sponge withdrawal. Ovulation rate (OR) of ewes ovulating was estimated by laparoscopy.

EXPERIMENTAL

Experiment 1

In September 1980 experiments at Shackleton and Gnowangerup tested the hypothesis that the 'ram effect' can replace the use of PMSG in synchronisation programmes in Western Australia. Oestrus was synchronised by Repromap sponges (Upjohn) in a total of 1,003 Merino ewes which were allocated to three treatments.

(i) Rams were introduced and 500 iu PMSG (Folligon) were injected at the same time as sponges were withdrawn.
(ii) Rams were introduced at the same time as sponges were withdrawn.
(iii) Rams were introduced 2 days before sponges were withdrawn.

In a control group of ewes (n=93) spontaneous ovulatory activity was estimated to be 36% and ovulation rate to be 1.33. The ovulation rate of the treated ewes was estimated from a sample of 506 ewes.

TABLE 1 Effect of day of introduction of rams and PMSG on ovulation rate and oestrus

Introduction of rams	Dose of PMSG	Ovulation rate	Ewes Marked (%)
At sponge withdrawal	500 iu	1.74	85
At sponge withdrawal	0	1.29	76
2 days before sponge withdrawal	0	1.23	93

The introduction of rams at 2 days before sponge withdrawal increased the number of ewes displaying oestrus compared to introduction of rams with or without PMSG, at sponge withdrawal ($P < 0.001$, Table 1). Injection of PMSG increased OR ($P < 0.001$). Introduction of rams 2 days early gave a synchrony of oestrus equal to that induced by PMSG but had no effect on OR. Neither treatment gave synchrony which could justify inseminating at a fixed time (Table 2).

TABLE 2 Effect of day of introduction of rams and PMSG on the synchrony of oestrus (ewes marked/total ewes marked, %)

Introduction of rams	Dose of PMSG	Time after sponge withdrawal (h) 28	44	52	68	76	92
At sponge withdrawal	500 iu	2	50	22	21	5	0
At sponge withdrawal	0	1	13	21	38	13	14
2 days before sponge withdrawal	0	11	50	26	13	0	0

Experiment 2

Experiment 1 was designed so that all rams were introduced at once. Consequently those ewes in which sponges were retained after the rams were introduced were exposed not only to rams but to rams actively mating with oestrous ewes before they themselves were expected in oestrus. In experiment 2 we tested the hypothesis that the presence of oestrous ewes may have augmented the improved response to the 'ram effect' in previous experiments. The effect of type of progestagen was also investigated.

The experiment was conducted at Gnowangerup using 650 Merino ewes in September 1981. Oestrus was synchronised with either (i) Repromap sponges, (ii) Repromap sponges and 500 iu PMSG at sponge withdrawal, or (iii) Chronogest sponges (Intervet). Rams, with or without oestrous ewes, were introduced to the three synchronisation treatments 2 days before the sponges were withdrawan. The proportion of oestrous ewes introduced with the rams was at least 5% of the size of the treatment group. Endoscopy on 50 control ewes showed that 24% were cycling spontaneously with an OR of 1.17. The. ovulation rate of the treated ewes was estimated from a sample of 141 ewes.

TABLE 3 Effect of progestagen and presence of oestrous ewes on ovulation rate and oestrus

Progestagen	Oestrous ewes	Dose of PMSG	Ovulation rate	Ewes marked (%)
Repromap[+]	-	0	1.52	71
	+	0	1.43	83
	-	500 iu	1.86	84
	+	500 iu	1.78	87
Chronogest[++]	-	0	1.42	86
	+	0	1.75	90

Chronogest sponges were as effective as Repromap sponges and PMSG for inducing oestrus and superior to Repromap alone ($P < 0.05$, Table 3), but synchrony of oestrus was improved by injecting PMSG (Table 4). PMSG increased OR ($P < 0.05$) above the 'ram effect' alone, but the 'ram effect' increased OR above the spontaneous OR ($P < 0.001$). The presence of oestrous ewes from two days before sponge withdrawal had no significant effect.

([+]60 mg, Medroxy-progesterone acetate)

([++]30 mg, Flurogesterone acetate)

TABLE 4 Effect of progestagen and presence of oestrous ewes on the synchrony of oestrus (ewes marked/total ewes marked, %)

Progestagen	Oestrous ewes	Dose of PMSG	Time after sponge withdrawal (h) 30	42	54	66	78	90
Repromap	-	0	0	10	49	29	6	6
	+	0	0	0	33	42	20	5
	-	500 iu	0	0	73	24	3	0
	+	500 iu	1	41	41	14	3	0
Chronogest	-	0	12	33	42	8	4	1
	+	0	6	29	47	13	4	1

Experiment 3

In the first experiment the presence of oestrous ewes may have confounded an improved response to the 'ram effect'. But the second experiment showed that the presence of oestrous ewes from two days before sponge withdrawal had no effect. A third experiment was conducted to test the hypothesis that an effect of the presence of oestrous ewes will be seen only if they are present from the time of the sponge withdrawal. The improved response with Chronogest sponges suggested that, in combination with PMSG, this treatment would induce sufficient synchrony to allow insemination at a fixed time.

Oestrus was synchronised by Chronogest sponges in a total of 982 Merino ewes which were allocated to an experiment with a factorial design. The factors were (i) introduction of rams on day 10 or 12 after insertion of sponges; (ii) injection of 0 or 500 iu PMSG at sponge withdrawal; and (iii) the presence or absence of oestrous ewes at the time of sponge withdrawal.

A control group showed that 12% were cycling spontaneously. Treatment with PMSG was the only factor to have an effect on the reproductive variables measured and the results are shown in Table 5.

TABLE 5 Effect of dose of PMSG on reproductive performance

Parameter	Dose of PMSG (iu) 0	500
Number of ewes	493	489
Ewes marked within 86 hours	52%	82%
Ovulation rate (n)	1.28 (92)	1.89 (99)
Unmarked ewes ovulated (%)	15/35 (43)	32/35 (91)
Ewes lambing of ewes inseminated	32%	43%
Lambs born per ewe lambing	123%	148%

PMSG increased the number of ewes displaying oestrus within 86 hours of sponge withdrawal ($P < 0.001$), increased ovulation rate ($P < 0.001$) and increased the proportion of ewes lambing ($P < 0.01$) and lambs born per ewe lambing ($P < 0.01$). Although PMSG advanced the time of onset of oestrus the synchrony of oestrus was not improved (Table 6).

Of the ewes which were not marked 91% of ewes which received PMSG had ovulated but only 43% of those which did not receive PMSG had ovulated.

The presence of oestrous ewes at the time of the introduction of rams increased the number of ewes lambing (absence 34%, presence 44%, $P < 0.05$).

TABLE 6 Effect of PMSG on the synchrony of oestrus (ewes marked/total ewes marked, %)

Dose of PMSG	Time after sponge withdrawal (h) 26	38	50	62	74	86
0	1	2	18	43	26	9
500 iu	2	26	39	26	5	2

Experiment 4

In this experiment we tested the hypothesis that ewes returning to anoestrus after being induced to ovulate could be stimulated to reovulate by a second use of intravaginal sponges, PMSG and the 'ram effect'.

A flock of 664 mature Merino ewes artificially inseminated (AI) after synchronised oestrus, and therefore were either pregnant or had failed to conceive, were allocated to a 2 x 2 design experiment. The factors were (1) progestagen priming (intravaginal sponges; Chronogest, Intervet) for 14 days from 10-13 days after AI or control (no intravaginal sponges) and (2) injection of 0 or 250 iu PMSG at sponge withdrawal or on day 12-15 post AI in control ewes. All ewes were maintained in isolation from rams from the time of AI until re-introduction at the time of injection of PMSG. Oestrus was detected for five days beginning on the day after injection of PMSG.

Treatment with PMSG increased the proportion of the non-pregnant ewes that returned to oestrus after AI (zero 56%, 250 iu 82%, $P < 0.001$). Treatment with intravaginal sponges increased the proportion of ewes pregnant to AI, and hence the proportion of the flock that lambed (Control 34%, sponge 45%, $P < 0.01$). Ewes which received no treatment (Control, no intravaginal sponge or PMSG) had a lambing rate among the non-returns of 46%, compared to 75% when ewes were treated with intravaginal sponges or PMSG.

CONCLUSIONS

Our experiments showed that the 'ram effect' was as effective as PMSG at inducing ovulation and oestrus in 2 of the 3 synchronisation experiments. In only one experiment the 'ram effect' stimulated an increased OR. Therefore at the present state of our knowledge PMSG seems essential to offset a possible poor response to the 'ram effect'.

We have been unable to demonstrate consistently any advantage of altering the day of introduction of rams relative to withdrawal of sponges nor a consistent role for the presence of oestrous ewes.

None of the synchronisation treatments gave a synchrony of oestrus that could justify inseminating at a fixed time, according to the criteria outlined by Colas and Cognie (1968) and Cognie et al (1970). Nevertheless, the high proportion of unmarked ewes which had ovulated suggests that all ewes which have not been marked within 72 hours of sponge withdrawal could be inseminated.

The post-insemination use of intravaginal sponges and PMSG improved the lambing rate among ewes which did not return to oestrus. However they operated by different mechanisms. PMSG ensured that most non-pregnant ewes returned, whereas intravaginal sponges increased the pregnancy rate of ewes inseminated.

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GENERAL DISCUSSION

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This contract has presented three alternative strategies for the synchronisation of ewes in spring. Each of the strategies uses the 'ram effect' in combination with progesterone or progestagens to synchronise oestrus. As to which method is chosen depends primarily upon the requirements of primary producers.

The single dose of progesterone injected immediately prior to the introduction of rams is the simplest and cheapest method to synchronise oestrus into a short period. However the method will not synchronise cyclic ewes in the flock and relies on ewes displaying oestrus at the time of their second ovulation. In addition, because of the risk of a poor ovulatory response to the 'ram effect' among anovular ewes or failure to reovulate among successfully stimulated ewes, we recommend treating 50-100% more ewes than are budgeted for insemination over the critical four days.

The short-term use of intravaginal sponges in seasonally anovular BL x M ewes stimulates a high proportion of ewes that are induced to ovulate to also display oestrus at the ram-induced ovulation, and therefore take advantage of any ram-induced increase in ovulation rate. On average 60% of BL x M ewes primed for 6 days lambed to ram-induced ovulations. An injection of PMSG at sponge withdrawal may give a more consistent increase in the fecundity of ewes at the synchronised oestrus but this advantage must be weighed against the extra cost of the PMSG.

The use of intravaginal sponges for 12-16 days is usually associated with artificial insemination. If the number of ewes to be synchronised is small or if particular matings are planned, then it is the most reliable method because it ensures that all ewes display oestrus with the ram-induced ovulation and also synchronises cyclic ewes in the flock.

The introduction of rams to anovular ewes, preconditioned by a period of isolation, does not guarantee that the ewes will ovulate in response to the 'ram effect' and experiments changing the time of introduction of rams with respect to the time of sponge withdrawal have not been able to consistently alter its efficacy. Thus the effectiveness of the synchronisation techniques depends on responsiveness to the 'ram effect'. These experiments have shown that ovulation can be reliably induced by treatment with PMSG and that fertility and fecundity are increased. If ovulation can be reliably induced then all ewes that have not displayed oestrus could be inseminated at a fixed time and hence potentially improve lambing results from ewes treated in synchronisation programmes.

Experiments with both methods using intravaginal sponges have shown variable effects of the presence of oestrous ewes on the induction of oestrus and lambing performance. The mechanisms are unknown but the phenomenon has the potential to improve reproductive performance of ewes in spring.

In south Western Australia it is well documented that a high proportion of ewes which mate and do not return to oestrus do not lamb (Knight et al. 1975). Ewes returning to anoestrus following successful stimulation by the 'ram effect' has been offered as an explanation for this phenomenon for flocks joined in spring (Oldham and Cognie 1980). This contract has also demonstrated that the induction of ovulation does not guarantee continued ovulatory activity. This problem could be solved by the injection of PMSG before the expected date of return to oestrus, and the mating of these ewes will improve the overall

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reproductive performance of ewes synchronised in spring.

The finding that progestagen priming from day 10 to day 24 post insemination augmented the fertility of Merino ewes in spring suggests a deficiency of progesterone around the time of implantation. The result could explain the effect of PMSG on the fertility of ewes inseminated, in terms of its effect on the ovulation rate of ewes. Ewes with more corpora lutea produce more progesterone and may therefore have a greater chance of maintaining their pregnancies.

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