THE CONCEPTION RATE OF EWES IN RELATION TO SPERM DOSE AND TIME OF INSEMINATION*

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The effect of different sperm doses on the conception rate has been studied by Salamon (1962), Gancev (1963) and Kareta, Osikowski & Wierzbowski (1966), but without relation to a possible effect of time of insemination. Jones, Martin & Lapwood (1969) and Entwistle & Martin (1972) studied the effect of restricted sperm doses (100×10^6 and 50×10^6 spermatozoa) and, by relating the results to vaginal mucus score, found that the highest conception rate occurred in ewes with a copious, clear or cloudy mucus at the time of insemination. On the other hand, in recent work in this laboratory (Amir & Schindler, 1972), it was shown that with the use of 300 to 500×10^6 freshly ejaculated spermatozoa, single inseminations of ewes were of uniform and high efficiency almost throughout oestrus. The present study was undertaken in order to investigate the possibility that the time range for obtaining maximal results may be more limited with reduced sperm numbers. The stages of oestrus were defined in terms of time intervals after its onset or before its end, since the mucus score was only a rough guide for the determination of the stage of oestrus (Schindler & Amir, 1972).

In the first experiment, a total of 206 cycling, non-lactating Awassi and German Mutton Merino ewes were inseminated. The onset and duration of standing heat were determined by teasing with aproned rams in small groups for 30 min at 8-hr intervals, under the close supervision of the herdsman. Ewes in oestrus were immediately withdrawn and teasing was continued at 8-hr intervals until after the end of heat, when they were returned to the flock. This procedure ensured equal exposure of all ewes to the rams and also made it possible to relate the insemination results to the end of oestrus.

Semen was collected with an artificial vagina from fourteen rams in a random sequence. Only ejaculates with strong wave motion and a minimum concentration of 3.5×10^9 spermatozoa/ml were used. The semen was immediately diluted at 30° C with reconstituted skimmed milk according to the method of Colas, Dauzier, Courot, Ortavant & Signoret (1968). The dilution ratio was adjusted for each ejaculate so as to provide 800×10^6 spermatozoa/ml. The diluted semen was kept at 25 to 30° C until insemination, which was carried out within 1 hr of ejaculation.

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Table 1. Conception rate of ewes inseminated with different sperm doses at different times after the onset of oestrus

Sperm dose ($\times 10^6$)	Hours after onset of oestrus								Total no. of insem.	% lambings
	0 to 8		8 to 16		16 to 24		24 to 32			
	No. of insem.	No. of lambings	No. of insem.	No. of lambings	No. of insem.	No. of lambings	No. of insem.	No. of lambings		
120	16	7	19	11	18	13	15	5	68	52.9
80	18	2	18	8	17	12	16	12	69	49.3
40	17	6	19	5	17	12	16	7	69	43.5
Total	51	15	56	24	52	37	47	24		
% lambings	30		43		71		51			

Table 2. Conception rate of ewes inseminated with different sperm doses at different times before the end of oestrus

Sperm dose ($\times 10^6$)	Hours before end of oestrus					
	0 to 8	8 to 16	16 to 24	24 to 32	32 to 40	>40
120	No. of insemin. 7	No. of insemin. 11	No. of insemin. 19	No. of insemin. 17	No. of insemin. 7	No. of insemin. 7
80	No. of lamblings 0	No. of lamblings 7	No. of lamblings 13	No. of lamblings 10	No. of lamblings 2	No. of lamblings 4
40	No. of insemin. 6	No. of insemin. 11	No. of insemin. 13	No. of insemin. 15	No. of insemin. 17	No. of insemin. 7
	No. of lamblings 2	No. of lamblings 8	No. of lamblings 9	No. of lamblings 9	No. of lamblings 5	No. of lamblings 1
	No. of insemin. 2	No. of insemin. 10	No. of insemin. 16	No. of insemin. 16	No. of insemin. 16	No. of insemin. 9
	No. of lamblings 0	No. of lamblings 5	No. of lamblings 10	No. of lamblings 7	No. of lamblings 6	No. of lamblings 2
Total	No. of insemin. 15	No. of insemin. 32	No. of insemin. 48	No. of insemin. 48	No. of insemin. 40	No. of insemin. 23
	No. of lamblings 2	No. of lamblings 20	No. of lamblings 32	No. of lamblings 26	No. of lamblings 13	No. of lamblings 7
% lamblings	13	62	67	54	32	30

Each ewe received a single insemination at 08.00 hours, immediately after the morning teasing. At that time, the ewes were at one of the following stages after the onset of heat: 0 to 8, 8 to 16, 16 to 24 or 24 to 32 hr. Ewes from each group were randomly assigned to one of the following semen doses: 0.05 ml (40×10^6 spermatozoa), 0.10 ml (80×10^6 spermatozoa) or 0.15 ml (120×10^6 spermatozoa).

For the second experiment, a total of 132 cycling, dry or milking Awassi ewes were used. They were teased at 12-hr intervals and a single insemination was performed 12 hr after oestrus had been detected, i.e. between 12 and 24 hr after its onset. The preparation of the semen, which was collected from sixteen rams in random sequence, and the semen doses applied were the same as in the first experiment.

Chi-squared analysis was applied to the experimental results.

The results of the first experiment are presented in Tables 1 and 2. From Table 1, it can be seen that a high conception rate was limited to inseminations performed 16 to 24 hr after the onset of oestrus. Inseminations performed earlier or later gave lower conception rates but the difference was statistically significant only for the results from the earlier inseminations.

When the times of insemination were related to the end of oestrus (Table 2), the best results were obtained from those inseminations performed between 8 and 24 hr, and intermediate results from those between 24 and 32 hr, before the end of oestrus. Inseminations performed earlier or later resulted in lower and statistically different conception rates.

The conception rates obtained from the three sperm doses (Table 1) decreased with decreasing sperm numbers but the differences were not statistically significant for the overall results or for the results at different stages of oestrus.

The insemination time in the second experiment (12 to 24 hr after the onset of oestrus) was chosen so as to overlap the period found to be optimum in the first experiment (16 to 24 hr after onset of oestrus), and feasible under farm flock conditions. The conception rates obtained with 120×10^6 (forty-one ewes), 80×10^6 (forty-six ewes) and 40×10^6 (forty-five ewes) spermatozoa were 68.3%, 67.4% and 55.5%, respectively, i.e. similar to those in the first experiment at that stage of oestrus. The differences between the conception rates were not statistically significant.

The results of the first experiment showed that highest conception rates were obtained when inseminations were performed 8 to 24 hr before the end of oestrus. This result is consistent with those of Mattner (1963), Quinlivan & Robinson (1967, 1969) and Lang & Oh (1970), who found that 16 to 24 hr after mating or insemination, the accumulation in the oviduct of spermatozoa which are gradually released from the cervical reservoir (Quinlan, Mare & Roux, 1933; Mattner, 1963, 1966) is at a maximum. When restricted sperm doses are used, inseminations carried out too early result in exhaustion of the sperm reserve before ovulation has taken place, which coincides, on average, with the end of oestrus in sheep (McKenzie & Terrill, 1937; Schindler & Amir, 1972). If insemination is too late, ovulation will occur before an adequate number of spermatozoa has accumulated at the fertilization site. With the use of large sperm doses, the time of insemination appears to be less critical (Amir

& Schindler, 1972), apparently because the sperm supply at the fertilization site becomes adequate, irrespective of the length of the period from semen deposition to ovulation. The necessity for correct timing when inseminating with reduced sperm numbers or stored semen is also indicated by the results of Salamon & Lightfoot (1970) and Salamon (1971), who showed that inseminations with frozen semen carried out 15 to 25 hr after the onset of oestrus were more efficient than those carried out 1 to 15 hr after the onset of oestrus.

From the results of inseminations with restricted sperm doses, conclusions can be drawn regarding artificial breeding management of ewes under feed lot or farm flock conditions. When the average duration of oestrus is 36 hr and the time of onset is not centered around any particular time of day, as in our experimental flocks (Schindler & Amir, 1972), detection of the ewes in heat at 12-hr intervals and insemination 12 hr later would ensure a maximal conception rate.

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