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Production of semen for artificial insemination from Alpine and Saanen bucks under different photoperiodic cycles

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Abstract

The aim of this study was to evaluate the various alternations between long and short days of sunlight in an attempt to optimise the production of semen collected for artificial insemination (AI) under field conditions. The results suggest that alternation between long days and short days allowed for the production of AI doses all year round in large scale under field conditions. The alternation 45 LD / 45 SD seems to be the better treatment to optimise the production of AI doses. Under these conditions the production of AI doses was not influenced by the rhythm of collection. More investigations are necessary to optimise the rhythm of weekly collection.

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Introduction

It has been proven in goat bucks that the alternation between long and short days of sunlight eliminates the seasonal variations in quantitative and qualitative characteristics of their semen (Delgadillo *et al*., 1991). In these studies bucks were exposed to the following alterations in photoperiods: 30/30, i.e. 30 long days of sunlight (16L:8D) and 30 short days of sunlight (8L:16D) or alternation 60/60, i.e. 60 long days (16L:8D) and 60 short days (8L:16D). Both treatments were similar but the photoperiod alternation 60/60 was applied routinely because it allowed for the production of more sperm per ejaculate than the alternation 30/30. The aim of this study was to evaluate the various photoperiod alternations between long and short days to optimise the production of AI doses of semen under field conditions.

Materials and Methods

The effect of the alteration between long and short days on the production of AI doses of semen was studied in Alpine and Saanen bucks over a period of three consecutive years at a private goat artificial insemination centre. Each year a control group (n = 8) was kept in open sheds under natural day length conditions, which varied from 16 h light at the summer solstice to 8 h light at the winter solstice. Each of three experimental groups was submitted to the photoperiodic treatment during 18 months. Bucks were 12-14 months old at the beginning of the experiment.

The experimental bucks were divided into two groups consisting of either four collections (n = 8) or three collections (n = 8) per week during 18 months including 2 x 6 months of a breeding season and 1 x 6 months of a non-breeding season. Semen from the bucks in the control groups was collected three times a week during two consecutive breeding seasons (2 x 6 months) (Table 1).

Table 1 Experimental design

Year	Experimental group (n)	Control group (1) (n)	Alternation: n long days (16L : 8D) – n short days (8L:16D) (2)
1	16	8	60-60
2	16	8	45-45
3	16	8	60-45

(1): natural day length; (2) 16L:8D: 16h light and 8 h darkness; 8L:16D : 8h light and 16h darkness

The sexual behaviour was assessed during each semen collection session by recording the percentage of bucks unable to ejaculate into an artificial vagina. The bucks have been trained previously to mount a teaser doe. The semen of bucks was collected simultaneously and in each collection session there was only one attempt to obtain an ejaculate. The total number of sperm per ejaculate was calculated by measuring the volume and sperm concentration with a spectrophotometer. Just after collection, the seminal plasma was removed and the ejaculates were treated according to the deep freezing procedure in skim milk and stored in 0.25 mL straws (100 x 10^6 sperm cells) (Corteel, 1974). The monthly number of AI doses produced was based on ejaculates with more than 30% motile sperm and a progressive motility of more than 2.5 at thawing.

The sexual behaviour, which is a binary variable, was analysed with the generalised linear model (Proc Genmod; SAS, 1988). Other variables were considered as quantitative, while Proc Mixed Model in the SAS system was used with treatment and rhythm of collection as fixed effects and buck as randomised effect.

Results and Discussion

The experimental design was based on a comparison year by year between one experimental group and its respective control group, and did not allow for a direct comparison between experimental groups, because of confounding effects between treatment and year effects.

The statistic analyses showed a photoperiodic effect on sexual behaviour ($P < 0.01$). The sexual behaviour at the collection session for the bucks submitted to the alternation 60/60 and the alternation 45/45 was less than their respective control groups (Table 2). For these two experimental groups, the rhythm of collection four times/week was more favourable than the three times/week. Only bucks submitted to the alternation 60/45 collected three times/week exhibited a sexual behaviour better than their control group.

Table 2 Effect of treatments and rhythm of collection on the sexual behaviour of bucks (% of ejaculates obtained at the collection session)

Alternation: Number of long days *vs*. number of short days	4 collections per week (%)	3 collections per week (%)	Control group: 3 collections per week (%)
60/60	90.9^{b}	90.1^{a}	96.3^{c}
45/45	90.8^{b}	83.2^{a}	95.5^{c}
60/45	85.6^{b}	91.7^{c}	84.9^{a}

Values in the same row with different superscripts are different ($P < 0.05$)

The average volume and concentration of sperm per ejaculate for experimental groups and control groups were 0.83 mL ± 0.46 and 3.87 x 10^9 ± 0.76 sperm cells/mL, respectively. Light treatments and rhythm of collection had slight effects on quantitative parameters of semen. Statistical analyses indicated than the concentration in sperm varied between experimental and control groups ($P < 0.01$) when the bucks were submitted to the alternation 45/45. The average concentration of ejaculates was higher for the three times per week group compared to the control group, respectively 4.0 x 10^9/mL and 3.25 x 10^9/mL.

Compared to the control group, the quality of semen after freezing varied unfavourably for the alternations 60/45 and 60/60, while the quality of semen from alternation 45/45 was similar to its control group. The percentage of motile sperm varied unfavourably in the alternation 60/45, collected four times per week ($P < 0.035$) and the sperm's progressive motility varied unfavourably to the alternation 60/45 ($P < 0.045$) and alternation 60/60 ($P < 0.046$), both collected four times per week (Table 3).

The monthly production of AI doses of semen (135 ± 52 doses) was similar for the experimental groups compared to the control groups. In spite of a favourable tendency observed when the sperm was collected four times a week, no effect was evident between each experimental group and its control group. The present findings confirmed that the three experimental groups subjected to monthly collections produced the same number of AI doses of semen as that of control groups under natural daylight length. Bucks subjected to such treatments can produce AI doses continuously, as shown by Delgadillo *et al.* (1993). These results indicate than short photoperiodic cycles eliminate the seasonal variations of sexual behaviour, semen quantity and quality as observed in control animals (Delgadillo *et al.*, 1992).

However, when comparing each experimental group with its respective control group, only the bucks submitted to alternation 60/45 had a better sexual behaviour during the collection session than the control group. On the other hand, the alternation 45/45 experimental treatment produced a higher concentration of sperm. Moreover, for alternation 45/45 the quality of semen after freezing was equivalent to that of the control while the quality of semen was less than that of the control group for the other experimental groups. Finally, under our experimental conditions the same number of AI doses of semen was produced irrespective of the alternation of long days or short days, or the rhythm of collection. Differences between groups could exist but they were probably masked by the large variations between bucks.

Table 3 Effect of treatments and rhythm of collection on semen quality parameters

Alternation: Number of long days *vs*. number of short days	4 collections per week	3 collections per week	Control group: 3 collections per week
60/60:			
- Progr. motility	2.28^{a}	$2.45^{a,b}$	2.61^{b}
- % of mobile sperm	42.8	46.2	47.8
45/45:			
-Progr. motility	2.28	2.26	2.30
- % of mobile sperm	41.3	39.7	42.4
60/45:			
- Progr. motility	1.77^{a}	$2.13^{a,b}$	2.22^{b}
- % of mobile sperm	31.9^{b}	38.5^{a}	39.9^{a}

Values in the same row with different superscripts are different ($P < 0.05$)

Conclusion

These results show that alternation between long days and short days makes it possible to produce AI doses all year round under large scale field conditions. The alternation 45/45 seems to be the better treatment to optimise the production of AI doses. Under these conditions the production of AI doses was not influenced by the rhythm of collection. More research is necessary to optimise the rhythm of weekly collection.

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