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Physiology

EFFECT OF SEASON ON DURATION OF ESTRUS, TIME OF OVULATION, AND FERTILITY OF SOWS IN A COMMERCIAL HERD

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Summary

Our objective was to examine the effect of season (spring, March vs. summer, August) and weaning-to-estrus interval (3, 4, 5, 6 d) on sow estrus, ovulation, and subsequent fertility characteristics. Duration of estrus (DE) and onset of estrus-to-ovulation interval (EOI) were estimated via boar exposure (plus back pressure test) and transabdominal real-time ultrasonography, respectively, every 6 h from 2 to 10 d postweaning in 174 sows (87 / season). Sows weaned in the spring compared to the summer had a decreased DE (53.1 vs. 60.8 h, $P < .001$) and EOI (38.1 vs. 48.5, $P < .001$). Season did affect insemination-to-ovulation intervals ($P < .002$) but there was no difference in spring vs. summer number of inseminations with 24 h prior to ovulation (1.3 vs. 1.3, $P > .9$), conception rate (94.6 vs. 90.5%, $P > .3$), farrowing rate (91.9 vs. 86.5%, $P > .3$), or pigs born alive (11.0 vs. 10.9, $P > .9$). In this particular herd, season altered duration of estrus, time of ovulation, and insemination-to-ovulation intervals but not enough to impact subsequent fertility. The multiple insemination schedule in place ensured that at least one insemination occurred within 24 h prior to ovulation in the majority of sows (90%). Additional herds are being studied to determine the consistency of these findings.

Introduction

A seasonal dip in sow fertility during the summer is a common and costly phenomenon in commercial swine production. Extra females (usually gilts) must be mated to meet farrowing targets since sows mated from July to September often exhibit a 10% decrease in farrowing rate and a 1 pig decrease in litter size compared to sows mated during the spring and winter (Love et al., 1993). Sows weaned from July to September also tend to take longer to return to estrus than at other times of the year (Claus and Weiler, 1985). Since there tends to be an inverse relationship between weaning-to-estrus interval (WEI) and duration of estrus (DE; Soede and Kemp, 1997), summer infertility may be due in part to a reduction of DE that leads to less synchronicity between detection of estrus and inseminations. Thus, the objective of this study was to examine the effect of season and WEI on DE, onset of estrus-to-ovulation interval (EOI), insemination-to-ovulation intervals, and subsequent sow fertility in a commercial herd.

Materials and Methods

Two groups of sows (total n = 87) were weaned on two consecutive Mondays in the spring (March) and summer (August) of 2000 (total n = 174) in a 2,500 sow commercial herd. Weaned sows represented lactation lengths of 13 to 19 d, parities of 1 to 10 and 3 genotypes. Effects of these factors on sow estrus and ovulation characteristics were reported previously (2001 Annual Swine Report). Weaned sows were housed in gestation crates in a curtain-sided, tunnel-ventilated barn equipped with a mist cooling system but no cool cells. The daily high barn temperature averaged 79.4°F in the spring and 85.9°F in the summer during the study. From the day of weaning (0 d) to 2 d postweaning sows were checked for estrus by the back pressure test during nose-to-nose contact with a mature boar at 0800 and 1400 h. From 2 d to 10 d postweaning detection of estrus was performed by the same means, but at 0800, 1400, 2000 and 0200 h and as sows exhibited estrus, the follicular status of their ovaries was examined by transabdominal real-time ultrasonography with an Aloka 500V equipped with a 3.5 MHz convex linear transducer (Aloka Co., Ltd., Wallingford, CT) at these same times until ovulation was confirmed. The mid-point between estrus checks and ultrasonography scans was considered the time of ovulation and onset/end of estrus, respectively. All sows that had not expressed estrus by 6 d were scanned to determine their ovarian status. Sows that failed to develop follicles and return to estrus by 10 d postweaning were considered anestrous. One hundred and fifty-three of the 174 weaned sows (88%) returned to estrus normally, within 2.5 to 7.0 d postweaning. These sows were inseminated with ≤ 2 d old semen during nose-to-nose boar contact by the farm's breeding technicians using EZ Mate breeding belts (Hampshire, IL) on an 0800 h day 1 of estrus, 0800 and 1500 h day 2 of estrus schedule. Twenty-one of the 174 weaned sows (12%) were excluded from the analysis because 5 returned to estrus ≤ 2 d postweaning (3 had multiple follicular cysts) and 16 remained anestrus for ≥ 10 d postweaning. The GLM procedure of SAS was used to examine the effects of season (spring, March vs. summer, August) and WEI (3, 4, 5, 6 d) on DE, EOI, and the percentage of DE at which ovulation occurred (SAS, 1990). There was no significant interaction between season and WEI for DE or percentage of DE at which ovulation occurred but there was a trend for an interaction for EOI (P < .08). The effect of season on insemination-to-ovulation intervals and subsequent reproductive performance was also assessed via GLM analysis. Data are expressed as LS means ± SEM.

Results and Discussion

Variation in DE (range, 12 to 84 h; mean ± SEM, 58.1 ± 1.0 h) and EOI (18 to 90 h; 44.1 ± 1.2 h) among the 153 sows analyzed is illustrated in figure 1. This variation is comparable to several previous reports in the literature (see review, Soede and Kemp, 1997) and it highlights the necessity of a multiple insemination strategy to ensure at least one insemination occurs near ovulation.

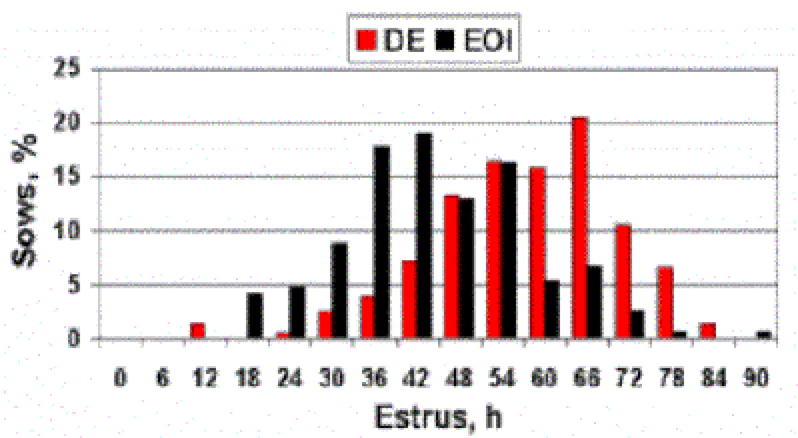

Figure 1. Frequency distribution of duration of estrus (DE) and onset of estrus-to-ovulation interval (EOI) among 153 weaned sows.

Sows did not have a significantly longer mean WEI in summer as compared to spring (4.5 ± 0.2 vs. 4.1 ± 0.2 d, P > .10), but this is somewhat misleading since more sows failed to return to estrus within 10 d postweaning (anestrus) and had to be excluded in the summer as compared to the spring (11 vs. 5 sows, P < .10). Sows weaned in the spring compared to the summer had a decreased DE (53.1 vs. 60.8 h, P < .001) and EOI (38.1 vs. 48.5, P < .001, Figure 2).

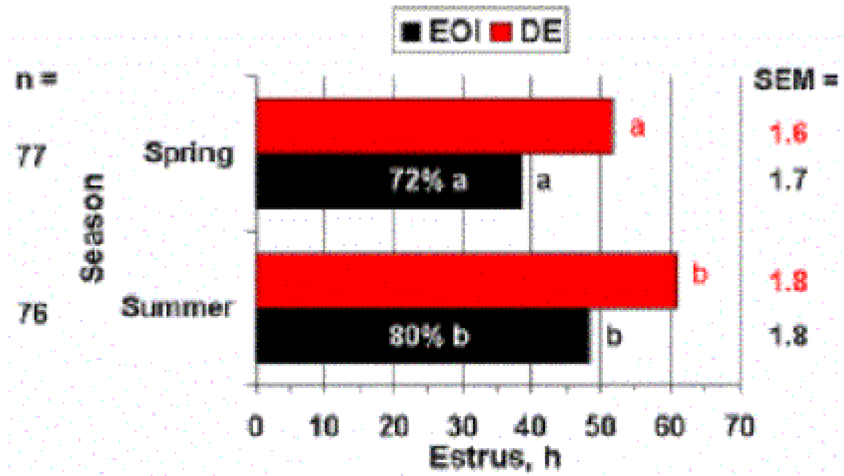

Figure 2. Effect of season on duration of estrus (DE) and onset of estrus-to-ovulation interval (EOI). Percentage of DE at which ovulation occurred is on the EOI bars. Like colored bars and percentages lacking common letters differ P < .05.

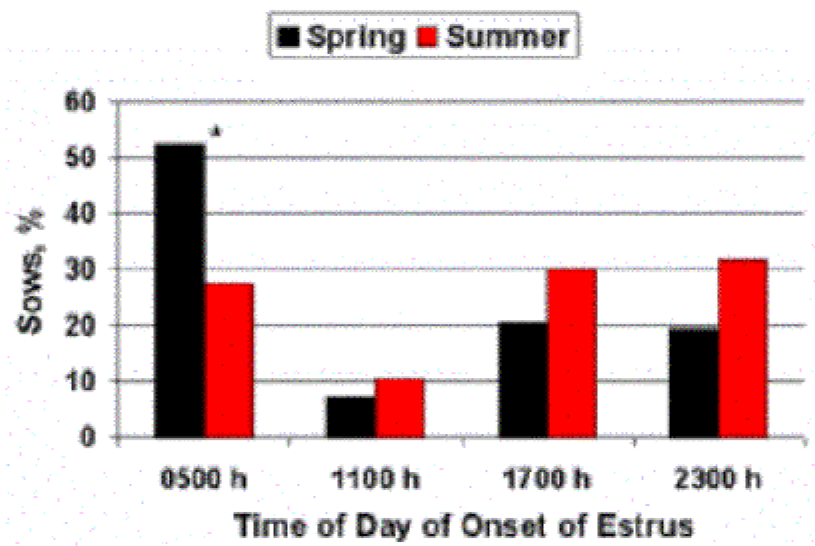

Figure 3. Effect of season on time of day of onset of estrus. Times are midpoints of examination intervals 0200 to 0800 h, 0800 to 1400 h, 1400 to 2000 h, and 2000 to 0200 h. * P < .05.

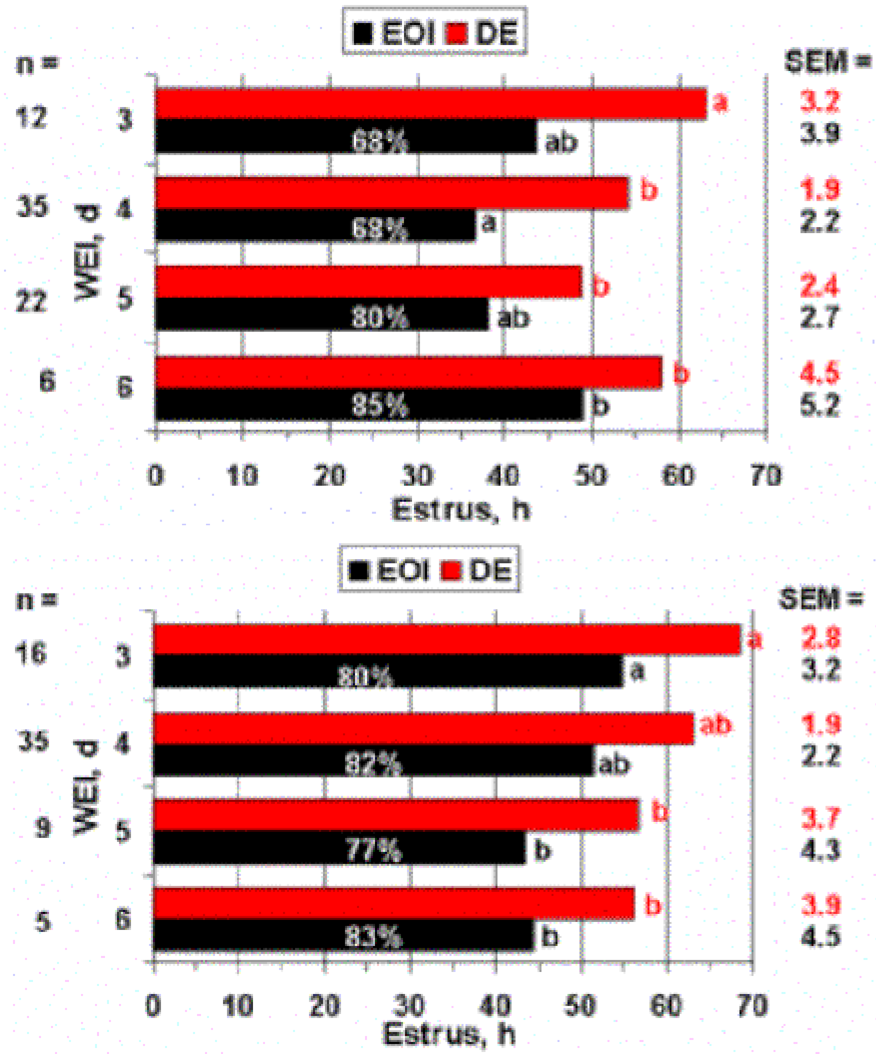

Figure 4. Effect of season (spring, top vs. suumer, bottom) and weaning-to-estrus interval (WEI, 3, 4, 5, 6 d) on duration of estrus (DE), onset of estrus-to-ovulation interval (EOI), and percentage of DE at which ovulation occurred (%). Like colored bars lacking common letters differ P < 0.05.

A longer DE in the summer compared to other seasons is in agreement with the limited published data available (Soede and Kemp, 1997). In addition, Perera and Hacker (1984) found that sows exposed to a constant 24 h light had a longer DE than sows on a 12 h light and 12 h dark cycle. Thus, the increasing daylight hours in the summer may increase DE by somehow altering sensitivity of the hypothalamus to estradiol (Cox et al., 1987). Even though the same person, boar, and technique were used to detect estrus in the spring and summer, there was a seasonal shift in the time of day that sows were first detected in estrus (Figure 3). In the spring compared to the summer, 52 vs. 28% ($P < .05$) of the sows came into estrus sometime between 0200 and 0800 h. The percentage of sows that came into estrus between 1400 and 2000 h and 2000 and 0200 h seemed to increase somewhat during the summer compared to the spring. This phenomenon has been shown to vary considerably between herds (Flowers, 1998).

When DE, EOI, and the percentage of DE at which ovulation occurred were compared by sow

WEI the pattern of change across WEI was somewhat similar to that suggested in the literature but differed by season. There was a weak negative correlation between WEI and DE in both seasons ($r = -.31$, $P < .01$). There appeared to be a stepwise decrease in DE and EOI as WEI increased from 3 to 5 d in both the spring and summer but DE and EOI failed to decrease further at a WEI of 6 d in the summer and seemed to increase in the spring (Figure 4). Statistically, significant differences for DE and EOI between WEI within season are marked (a, b) on the figures. The percentage of DE at which ovulation occurred remained relatively constant across the different WEI in the summer (≈ 80%) but increased numerically as WEI increased in the spring (68 to 85%). One possible explanation for the failure of sows with a WEI of 6 d to follow the pattern suggested in the literature, and have a shorter DE and EOI than sows with a WEI of 5 d may be explained by the small number of sows (n = 5 to 6) in the 6 d WEI category. Indeed, sows that had a WEI of 7, 8, 9, or 10 d (2 in the spring and 8 in the summer) had to be excluded from the analysis since there were to few to estimate DE and EOI.

The increased DE and EOI in the summer resulted in increased insemination-to-ovulation intervals in the summer compared to the spring ($P < .001$, Table 1). This shift in the timing of inseminations relative to ovulation did not however affect sow conception rate, farrowing rate, total born, or born alive. The number of insemination within 24 h prior to ovulation was similar in the spring vs. the summer, but there were more post-ovulation and post-estrus inseminations in the spring than the summer ($P < .005$ and $P < .03$, respectively).

Table 1. Effect of season on insemination-to-ovulation intervals, post-ovulation and post-estrus inseminations, and sow reproductive performance.

	Spring	Summer	P-value
0800 h, day 1 Insemination-to-Ovulation, h	30.6 ± 1.8	39.7 ± 1.9	< .001
0800 h, day 2 Insemination-to-Ovulation, h	6.6 ± 1.8	15.8 ± 1.9	< .001
1500 h, day 2 Insemination-to-Ovulation, h [a]	- 0.4 ± 1.8	8.8 ± 1.9	< .001
Inseminations Within 24 h Prior to Ovulation	1.3 ± 0.1	1.3 ± 0.1	> .9
Post-Ovulation Inseminations	0.8 ± 0.1	0.4 ± 0.1	< .005
Post-Estrus Inseminations	0.3 ± 0.1	0.1 ± 0.1	< .03
Conception Rate, % [b]	94.6 ± 3.1	90.5 ± 3.1	> .3
Farrowing Rate, %	91.9 ± 3.6	86.5 ± 3.6	> .3
Total Born	12.3 ± 0.4	11.5 ± 0.5	> .2
Born Alive	11.0 ± 0.4	10.9 ± 0.5	> .9

[a] A negative value indicates that this insemination occurred after ovulation on average

[b] Based on 30 d postmating RTU examination by farm manager

Sows that received 0 vs. 1 or 2 inseminations within 24 h prior to ovulation had similar conception and farrowing rates ($P > .7$) but tended to have fewer pigs born alive ($P < .09$, Table 2).

Table 2. Effect of number of inseminations within 24 h prior to ovulation on sow reproductive performance. Means lacking a common letter within a column differ P < .10.

Inseminations Within 24 h Prior to Ovulation	Conception Rate, % *	Farrowing Rate, %	Total Born	Born Alive
0 (n = 15)	93.3 ± 6.8	86.7 ± 8.1	10.5 ± 0.9[a]	9.5 ± 0.9[a]
1 (n = 59)	91.2 ± 3.2	86.8 ± 3.8	12.3 ± 0.5[b]	11.3 ± 0.5[b]
2 (n = 63)	93.8 ± 3.3	92.3 ± 3.9	12.5 ± 0.4[b]	11.3 ± 0.4[b]
* Based on 30 d postmating RTU examination by farm manager				

Implications

These data indicate that season does have some impact on duration of estrus and time of ovulation. In this particular herd however, sow fertility was not altered by an approximately 8 h increase in duration of estrus and a 10 h increase in the onset of estrus to ovulation interval from spring to summer because the multiple insemination schedule in place ensured that 90% of the sows mated received at least one insemination within 24 h prior to ovulation. There was an inverse relationship between duration of estrus and weaning-to-estrus intervals from 3 to 5 d, but not 3 to 6 d, as described in the literature. Depending on the specific herd and insemination program, seasonal changes in estrus and ovulation characteristics may or may not affect sow fertility.

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