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Effects of post-weaning altrenogest treatment in primiparous sows

Effect van altrenogesttoediening na het spenen aan primipare zeugen

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ABSTRACT

Major losses of body weight and fat reserves during the first lactation are a cause of unsatisfying reproductive performances in primiparous sows. This study, conducted in three commercial sow herds, investigated whether weaning the sows three days earlier together with administering altrenogest was effective for improving reproductive performance (weaning-to-estrus interval, pregnancy rate after first insemination, total litter size and number of live born piglets in the second litter) and body condition. In the herds suffering from the second litter syndrome, a non-significant improvement of the second litter size was found with on average 1.9 extra piglets born. During the treatment period, the treated sows gained on average 1.4 mm back fat, while the control sows lost 0.4 mm back fat. In conclusion, the treatment is useful for putting the sows in better condition at the moment of insemination and it may possibly improve reproductive performance in farms with the second litter syndrome.

SAMENVATTING

Een aanzienlijk gewichtsverlies en de uitputting van vetreserves gedurende de eerste lactatie zijn een oorzaak van verminderde vruchtbaarheid bij primipare zeugen. In deze studie, uitgevoerd op drie commerciële varkensbedrijven, werd nagegaan of het drie dagen vroeger spenen samen met de toediening van altrenogest effectief was om de vruchtbaarheid (interval van het spenen – de bronst, het drachtigheidspercentage na de eerste inseminatie, de totale worpgrootte en het aantal levend geboren biggen in de tweede worp) en de conditie te verbeteren. Op de twee bedrijven met het “second litter syndrome” werd een niet-significante verbetering van de worpgrootte met gemiddeld 1,9 extra biggen in de tweede worp vastgesteld. Gedurende de behandelingsperiode kwamen de behandelde zeugen gemiddeld 1,4 mm spekdikte bij terwijl de controlezeugen 0,4 mm verloren. We kunnen besluiten dat de behandeling nuttig is om een betere conditie van de zeugen te bereiken op het moment van inseminatie en dat het middels die behandeling mogelijk zou zijn de tweede worpgrootte op bedrijven met het “second litter syndrome” te verbeteren.

INTRODUCTION

Primiparous sows represent 15% to 23% of the sow population of a pig herd with an optimal parity distribution (D’Allaire and Drolet, 2006). Reports from veterinary practice and epidemiological research (Morrow *et al.,* 1992) state that primiparous sows may show unsatisfying reproductive performance characterized by: (1) an extended weaning-to-estrus interval (WEI) (Maurer *et al.,* 1985; Martinat-Botté *et al.,* 1985; Koketsu and Dial, 1997; Guedes and Noguera, 2001; Knox and Rodriguez Zas, 2001; Tummaruk *et al.,* 2001); (2) a lower pregnancy rate after first insemination (Martinat-Botté, 1985; Sterning and Lundeheim, 1995), and (3) a reduced subsequent litter size, with the litter being of the same size or even smaller than the first litter, (called ‘the second litter syndrome’) (Love, 1979; Esbenshade *et al.,* 1986; Morrow *et al.,* 1992; Whittemore, 1996; Le Cozler *et al.,* 1997; Tummaruk *et al.,* 2001; Kemp and Soede, 2004).

In the European pig production system, a minimum lactation period of 3 weeks is compulsory (Commission Directive 2001/93/EC of 9 November 2001) and 26 days is common. Reproductive problems in primiparous sows may be due to a major loss of body weight and fat reserves during this long lactation period (Einarsson and Rojkittikhun, 1993; Dourmad *et al.,* 2001; Eissen *et al.,* 2003; Willis *et al.,* 2003; De Rensis *et al.,* 2005). Good body condition is important for longevity (Young *et al.,* 1991; Brisbane and Chesnais, 1997; López-Serrano *et al.,* 2000), well being (Dourmad *et al.,* 2001) and reproductive performance (ten Napel *et al.,* 1995; Whittemore, 1996; Maes *et al.,* 2004). Especially in primiparous sows, it is very important to stimulate feed intake during lactation because their nutritional requirements include not only maintenance and lactation, but also further growth. In addition, primiparous sows have a lower feed intake capacity than older sows and they lack substantial reserves of fat and protein (ten Napel *et al.,* 1995). Factors that promote good appetite during lactation include good body condition at the time of parturition, optimal temperature in the farrowing unit, gradual buildup of the feed intake during lactation, and the offering of tasty food several times a day (Kemp and Soede, 2004).

The sow can also be given more time to get back into decent condition after weaning. This can be accomplished by skipping a heat. Unfortunately, this leads to a significant increase in the number of nonproductive days. Another possibility is to increase the weaning-to-conception interval by using altrenogest, a synthetic progestagen whose physiological effects are similar to the sow's own progesterone. With administration of 20 mg a day, the reproductive cycle of the sow is blocked at the end of the luteal phase. In primiparous sows, a 3-day post-weaning treatment appeared to be more effective than a 5-day treatment (Forgerit *et al.,* 1995; Martinat-Botté *et al.,* 1995), considering WOI, heat synchronization and fertility rates. A tendency to improved litter size has been reported after a 3-day post-weaning treatment (Martinat-Botté *et al.,* 1985; Forgerit *et al.,* 1995) and after a 7-day post-weaning treatment (Stevenson *et al.,* 1985; Kirkwood *et al.,* 1986). A significant difference in litter size was only reported by Morrow et al. (1989) in a 10 day post-weaning treatment. In all these cited studies, altrenogest was given after the sows were weaned at the normal point in time. Consequently, the number of non-productive days was increased and, in the case of a batch production system, the treated animals no longer fit in their group. This makes all these treatments unsuitable for today's batch production systems.

The aim of this study is to test a possible strategy for preventing reproductive problems after weaning and for ameliorating the second litter size without increasing the number of non-productive days. The strategy consists of weaning primiparous sows three days earlier (at 23 days of lactation), together with a 4-day administration of altrenogest (Regumate®, Janssen Animal Health), starting the day before weaning. During these three days, treated sows do not have to use body reserves to produce milk for the large piglets. By administering altrenogest during these days, the weaning-to-conception-interval is lengthened. Due to the earlier weaning, this strategy does not involve an increase in the number of non-productive days.

MATERIALS AND METHODS

Study population

The study was conducted in three commercial pig herds. The selection criteria for the herds were: producing in a 3-week batch production system, recording reproductive parameters of the sows, a herd size of minimum 200 sows and willingness to cooperate. A description of the herds is given in Table 1. In total, 100 primiparous sows were included in the study (17, 26 and 57 gilts from herds A, B and C, respectively). The study was conducted between August 2005 and April 2006. In herds A and B, the second litter size was smaller than the first litter size. This was not the case in herd C. Before the start of the study, all the sows in the three herds were weaned 26 days after farrowing (on Thursday morning). Heat detection was performed two times a day with a boar, and the sows were inseminated twice during heat.

Experimental design

Time of weaning and administration of altrenogest

At farrowing, the gilts within each herd were divided at random into two groups. The sows in the treatment group were weaned at 23 days after farrowing (Monday). The sows in the control group were weaned as usual, at 26 days after farrowing (Thursday). Starting the day before weaning (Sunday), the treated sows received 20 mg altrenogest (Regumate®, Janssen Animal Health) on their feed during four successive days at 8.00 am. All the sows in herd A and C stayed in the farrowing unit until day 26 after farrowing. They were fed lactational feed ad libitum. In herd B, the sows were moved to the breeding unit immediately after weaning and fed gestational feed ad libitum from the moment of weaning. The sows were weaned at 4.00 am in herd A and at 9.00 am in herds B and C.

Reproductive parameters

The following reproductive parameters were collected: the WOI, in this case the period between day 26 after farrowing and the first insemination; the number of sows in heat within the first 10 days after weaning or the end of the treatment; the pregnancy rate after insemination during the first estrus; the number of sows returning to estrus at regular and irregular intervals; the number of total born (live born and stillborn) and live born piglets in the second litter.

Body condition parameters

Body condition was assessed using back fat measurements with a 5 MHz linear probe ultrasound (Tringa 50 S, Esaote Pie Medical Tringa Linear, Maastricht, The Netherlands). The back fat at the 10th rib (P2) of all the sows was measured (method according to Gresham, 2000) at different subsequent moments during the reproductive cycle: 3 weeks before the

Table 1. Descriptive data of the three herds in the trial 3 months before the study.

Parameter	Herd A	Herd B	Herd C
Herd size (no. of sows)	280	600	700
Breed of the sows	topigs 20	topigs 40	topigs 20
Average age at first insemination (days)	245	246	243
No. of farrowings per sow per year	2.40	2.24	2.32
Total no. of piglets born per sow per year	29.48	27.24	30.28
No. of piglets weaned per sow per year	25.67	22.95	26.43
Average no. of live born piglets per litter	12.26	12.28	12.98
Average no. of stillborn piglets per litter	0.74	0.75	0.88
Average weaning-to-conception interval	5.18	9.15	5.26
Housing pregnant sows (D30-D108)	individually	in group	in group
Type of feed during gestation	pellets	pellets	meal
Energy value of gestational feed (EW)*	1.05	0.99	0.99
Energy value of gestational feed during last week (EW)*	1.05	1.02	0.97
Kg feed per day during first month of gestation	2.5	*ad libitum*	2.4
Kg feed per day during gestation (D30-D108)	3	*ad libitum*	2.6
Kg feed per day during last week of gestation	3.5	*ad libitum*	2.8
No. of feedings per day during gestation	1	*ad libitum*	*ad libitum*
Type of feed during lactation	pellets	pellets	pellets
Energy value of lactational feed (EW)*	1.15	1.05	1.12
Kg feed per day during lactation (from day 10 on)	*ad libitum*	*ad libitum*	*ad libitum*
No. of feedings per day during lactation	2	2	3
Origin of semen	AI centre	own boars	AI centre
Breed of the boars	Piétrain	Piétrain	Piétrain
Average total number of piglets born in the first litter	14.25	13.25	13.50
Average total number of piglets born in the second litter	13.17	11.40	14.58
No. of gilts included in the trial	17	26	57

* 1 EW = 2.1 Mcal Net Energy = 8.79 MJ Net Energy

first farrowing, at farrowing, 23 days after farrowing (weaning day of treatment group, Monday), 26 days after farrowing (weaning day of control group, Thursday), one month after insemination, 3 weeks before the second farrowing and at the second farrowing.

Statistical analyses

The differences between the two groups in terms of the reproductive parameters after weaning and in the second litter were analyzed for each herd separately by means of analysis of variance in the case of continuous parameters (total litter size, number of live born and stillborn piglets and WOI) and through Fisher's Exact test in the case of dichotomous variables (whether in heat within 10 days after weaning or not, pregnant after first insemination or not). For the difference in litter size between the first and the second litter, a paired t-test was used. The data of herds A and B were also analyzed together with a linear mixed model for continuous parameters or a logistic regression model for dichotomous parameters in which the effect of the herd was taken into account.

At first, differences in back fat between treated and control sows were analyzed using a repeated measurements analysis of variance. Because of significant interactions at several moments, the differences in back fat between the treatment group and the control group were analyzed separately for each herd and moment by means of analysis of variance. Back fat level changes between day 23 and day 26 (treatment period) and during the entire lactation period were analyzed for all the sows in both groups by means of a linear mixed effects model and for each herd separately through analysis of variance. The same analyses were performed for the back fat changes during the first month of gestation and during the entire second gestation. All the analyses were performed using S-PLUS 6.1. (Insightful Corp., Seattle, USA). A difference was considered to be significant when $P<0.05$.

RESULTS

Reproductive parameters

The reproductive results are summarized in Table 2. In herds A and B, the total second litter size of the control sows was numerically lower than their first

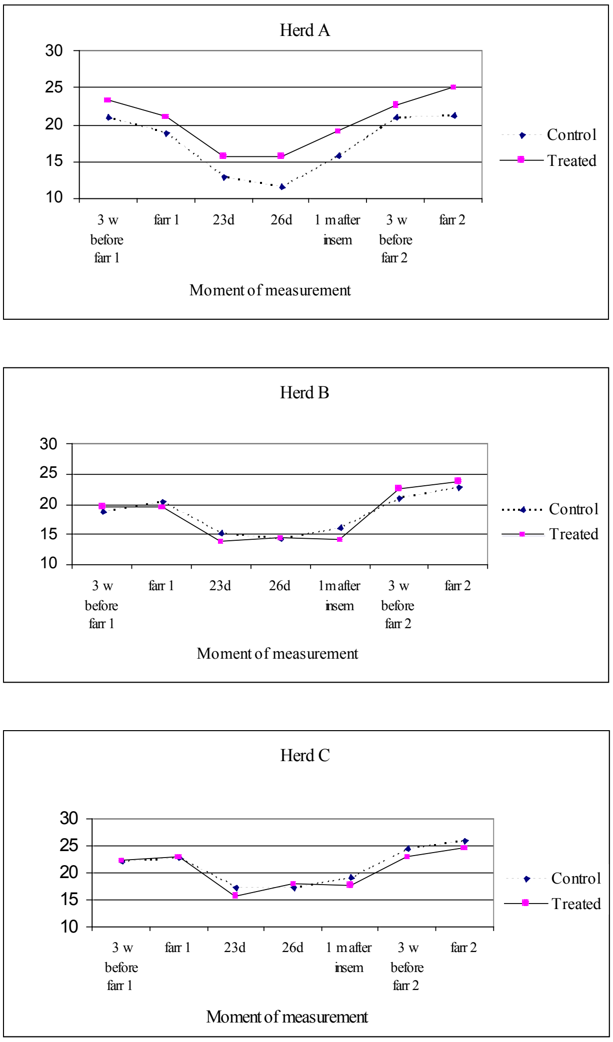

Figure 1. Back fat levels of the treated and the control sows in herds A, B and C at three weeks before the first farrowing, the first farrowing, 23 and 26 days after farrowing, one month after insemination, three weeks before the second farrowing and at the second farrowing.

litter size (a difference of 1.1 piglets in herd A and 1.9 piglets in herd B). In herd C, the second litter size of the control sows was significantly higher than the first (1.1 piglets) (P=0.028). The reproductive parameters were investigated for each herd separately and for herds A and B together because these two herds suffered from the 'second litter syndrome'.

The WOI of the treated sows was significantly longer in herd A (P=0.001), while it tended to be shorter in herds B and C (P>0.05). In herds A and B together, the interval was 1.0 day longer in the treated sows than in the control group (P<0.05). The number of sows showing estrus within 10 days after weaning and the percentage of regular and irregular repeat breeders did not significantly differ between the two groups. The pregnancy rate after first insemination did not differ between herd A and herd B, but was higher in the control group in herd C (P<0.001).

No significant differences were found between the treated and the control group concerning total litter size, number of live born piglets or number of stillborn piglets in the second litter. The results were numerically better for treated sows in herds A and B (on average 1.9 extra total born), while the opposite was observed in herd C (1.0 piglet less in the treatment group).

Body condition parameters

Overall, the back fat levels decreased during lactation and increased during gestation (Figure 1). Back fat level changes were quite similar for the two groups, except between day 23 and day 26 of the lactation (treatment period) and during the first month of the subsequent gestation. Between day 23 and 26, there was an increase in back fat level in the treatment group (+1.4 mm) and a further decrease in the control group (-0.4mm) (P<0.001). The changes in back fat during the treatment period (day 23 - day 26) were significantly different between the two groups, both in general as for each herd separately. During the first month of gestation, back fat levels increased in both groups but the increase was more pronounced in the control group than in the treatment group (P<0.01). An overview of the changes in back fat during the different periods is given in Table 3.

DISCUSSION

The influence of weaning three days earlier – together with the administration of altrenogest – on reproductive parameters and body condition was investigated in this study. The goal of the treatment is to prevent or reduce diminished reproductive results in primiparous sows after weaning and in the second litter.

The effects of the treatment on the reproductive parameters are not univocal. The different results in the herds can be explained by the fact that there were no problems with diminished production of primiparous sows in herd C, which was included in the study to evaluate the effects of the treatment in a herd without second litter syndrome. It was shown that in this type of herd, the treatment cannot further improve reproductive performance.

The longer WOI in treated sows in herd A might be explained partially by the difference in moment of weaning of the control sows (4.00 am) and the moment of altrenogest administration (8.00 am). The inhibition by the suckling stimulus in the control sows is elevated early in the day, while the treated sows are still under the influence of their last portion of altrenogest. In herds B and C, the WOI was slightly shorter in the treated group. This might be explained by the fact that altrenogest treatment is slightly less suppressive on the ovarian cycle than lactating (Soede et al. 2004) or by the better metabolic state of the treated sows due to their regaining back fat during the treatment period.

The lower pregnancy rates in treated sows in herd C (P<0.001) and to a lesser degree in herd B (P>0.05) were quite surprising because the opposite was expected. The lower rates were probably due to inadequate insemination management. On both farms, some of the treated sows had been in heat during the weekend. Unlike in herd A, the treated sows in herds B and C showed r weaning (end of altrenogest

Table 2. Reproductive parameters[ab] of the sows in the treatment group and the control group of the first litter; after weaning and of the second litter in herds A, B and C and for herds A and B together.

	Herd A		Herd B		Herd C		Herd A+B	
	Treated	**Control**	**Treated**	**Control**	**Treated**	**Control**	**Treated**	**Control**
No. of sows in the trial	9	8	14	12	29	28	23	20
Total litter size of first litter	13.8 (2.4)	14.3 (2.4)	13.4 (2.1)	13.3 (1.4)	12.6 (3.0)	13.5 (2.3)	13.5 (2.2)	13.7 (1.9)
No. of live born piglets in the first litter	12.8 (2.2)	13.3 (2.1)	12.5 (2.2)	12.8 (1.4)	12.0 (3.1)	12.4 (2.8)	12.6 (2.1)	13 (1.7)
No. of stillborn piglets in the first litter	1.0 (1.3)	1.0 (1.4)	0.9 (1.0)	0.4 (0.5)	0.6 (0.8)	1.0 (1.3)	0.9 (1.1)	0.7 (1.0)
No. of piglets weaned in the first lactation	11.1 (0.6)	11.4 (1.1)	10.8 (1.3)	10.1 (2.5)	10.8 (1.2)	10.1 (1.9)	10.9 (1.1)	10.6 (2.1)
Weaning-to-estrus interval	**6.8 (1.6)**	**4.0 (0.8)**	4.5 (1.3)	4.7 (1.2)	4.1 (0.3)	4.2 (0.4)	**5.4 (1.8)**	**4.4 (1.0)**
Pregnancy rates after first insemination (%)	100	75	71	83	**60**	**100**	83	80
Total litter size of second litter	13.7 (3.5)	13.2 (1.9)	14.3 (2.2)	11.4 (4.9)	13.6 (4.1)	14.6 (2.9)	14.0 (2.8)	12.1 (4.1)
No. of live born piglets in the second litter	13.4 (3.5)	12.8 (1.7)	13.5 (1.7)	10.6 (5.1)	12.8 (3.9)	13.5 (4.1)	13.5 (2.6)	11.4 (4.2)
No. of stillborn piglets in the second litter	0.2 (0.4)	0.3 (0.5)	0.8 (0.8)	0.8 (0.8)	0.8 (1.0)	1.1 (2.8)	0.5 (0.7)	0.6 (0.7)

a The values of continuous parameters are presented as average (standard deviation).
b Significant differences are marked in **bold**.

Table 3. Changes in back fat in mm during the treatment period (D23-D0); the total lactation (D26-D0); the first month of gestation (1month after insemination-D26) and the total second gestation (farrowing of the second litter-D26) with P-values.

	Herd A			Herd B			Herd C			Total		
			P-value			**P-value**			**P-value**			**P-value**
D23-D0	0.0	-1.4	0.050	0.6	-0.8	0.020	2.1	0.1	<0.0001	1.4	-0.4	<0.0001
D26-D0	-5.3	-7.3	0.303	-5.1	-6.2	0.343	-5.0	-5.1	0.651	-5.9	-5.9	0.206
1m-D26	3.4	4.2	0.817	-0.3	1.9	0.080	-0.1	1.8	0.024	0.6	2.3	0.009
2nd -D26	9.3	9.7	0.924	9.5	8.5	0.304	6.7	8.6	0.396	8.0	8.9	0.946

treatment)-to-estrus interval. The sows were not inseminated until Monday because there was no semen available during the weekend. In herd A, the farmer did inseminate during the weekend. Therefore the lower pregnancy rates in herds B and C might be due to a late insemination of sows that came in heat early (Kemp and Soede, 1996). These results suggest that proper heat detection and an optimal moment of insemination, namely within 24h before ovulation, are very important when this strategy is used. For the farmer it is important to be aware of possible differences in WOI between treated and non-treated animals. One can try to equalize them by adjusting the length of the treatment and/or the moment of altrenogest administration.

In herds A and B, where the second litter syndrome was prominent, a clear but statistically non-significant tendency to larger second litters in treated sows compared to control sows was observed. In herd C, where there was no problem with second litter syndrome and where the loss of condition during lactation was limited, the treatment did not further ameliorate the results. The outcome of this trial indicates that weaning earlier together with altrenogest administration might be useful in herds with the second litter syndrome while no better results are to be expected in herds without this problem. A larger study with more sows and/or herds should by carried out to confirm these tendencies.

An increase in the number of live born piglets in the second litter (treatment group compared to control group) of 0.6 piglets (herd A) or 2.9 piglets (herd B) constitutes a significant economic gain for the farmer and will outweigh the expense of the altrenogest and the extra labor (administering altrenogest and weaning earlier).

Even during this short treatment period of three days, the treated sows already gained back fat while the control sows further lost back fat. This shows that the treatment is effective in preventing back fat losses or even regaining condition at the end of the lactation. The total back fat loss of the control sows during the entire lactation period was most pronounced in herd A (-7.3 mm) and least in herd C (-5.1 mm). This fact, and the fact that the control sows in herd C did not lose any weight during the treatment period (+0.1 mm) can be explained by the higher feeding frequency in the farrowing unit in herd C (3 times a day versus 2 times in the other herds), by the limited number of piglets allowed to be raised by first litter sows (maximum 10), and possibly by generally better herd management in herd C (O' Dowd *et al.,* 1997; Dourmad *et al.,* 2001; Eissen *et al.,* 2003; Maes *et al.,* 2004). This also figures in the higher number of piglets weaned per sow per year in herd C (26.43) compared to herd A (25.67), although both herds use the same genetics and batch production system.

The larger gain of back fat during the first month of gestation in the control sows (+2.3 mm) compared to the treated sows (+0.6 mm) might also be explained by management actions: sows that have lost a lot of weight are fed more during gestation to obtain a sow population that is homogenous in condition by the time of farrowing. Since the maximum litter size is set by the number of ovulations, the quality of the eggs and the degree of embryonic death (Deckert and Dewey, 1994), it is important that sows be in good condition during follicle development and insemination. Thus being in good condition during this period of time takes priority over regaining good condition during gestation.

CONCLUSIONS AND IMPLICATIONS

Weaning primiparous sows three days earlier and administering altrenogest during this period did not lead to a significant improvement in the WOI and pregnancy rate in this study. In the herds with second litter syndrome, a beneficial non-significant increase in litter size was noted. To prevent negative effects of the treatment on pregnancy rates, it is important to attune the heat of treated and non-treated sows so that insemination at the right moment is possible.

The loss of back fat during the lactation of primiparous sows can be limited by weaning the sows three days earlier. The extent of the limiting effect differs from herd to herd and is more pronounced when the total loss of back fat during the entire lactation is larger.

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