รายงานวิจัยฉบับสมบูรณ์

โครงการ อิทธิพลของอายุเมื่อถึงวัยเจริญพันธุ์ในสุกรสาวต่อประสิทธิภาพทางระบบสืบพันธุ์

(Influence of age at puberty in gilts on their subsequent reproductive performance)

โดย

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มิถุนายน 2547

สัญญาเลขที่ TRG4580021

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สนับสนุนโดยสำนักงานกองทุนสนับสนุนการวิจัย

บทคัดย่อ

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ชื่อโครงการ: อิทธิพลของอายุเมื่อถึงวัยเจริญพันธุ์ในสุกรสาวต่อประสิทธิภาพทางระบบสืบพันธุ์

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การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาการเข้าสู่วัยเจริญพันธุ์ในสุกรสาวพันธุ์ผสม แลนด์เรซ-ยอร์กเชียร์ (LY) ที่ถูกเลี้ยงภายใต้สภาวะอากาศร้อนชื้น ทำการศึกษาในฟาร์มสุกรขนาด 2,400 แม่ แห่งหนึ่ง เป็นเวลา 1 ปี มีสุกรจำนวน 659 ตัว ถูกนำเข้ามาศึกษา ตัวอย่างอุจจาระจากสุกรสาวจำนวน 214 ตัว ถูกนำมาวิเคราะห์ฮอร์โมนโปรเจสเตอโรนในอุจจาระในช่วงเข้าสู่วัยเจริญพันธุ์ การตรวจฮอร์โมนโปรเจสเตอโรนใช้ชุดทดสอบมาตรฐาน ^{125} I-radioimmunoassay สุกรสาวที่นำมาใช้ในการทดลองเข้าฝูงครั้งแรกเมื่ออายุ 173.5+10.7 วัน น้ำหนัก 95.4 + 10 กก. และความหนาไขมันสันหลัง (BF) 11.8 + 2.5 มม. ระยะเวลาตั้งแต่เข้าฝูงถึงแสดงการเป็นสัดครั้งแรก (EOI) เฉลี่ย 22.0 + 15 วัน (พิสัย 1-58 วัน) สุกรสาวที่เข้าสู่วัยเจริญพันธุ์ในฤดูหนาว (110.1 กก. 13.9 มม.) และฤดูฝน (109.8 กก. 13.4 มม) มีน้ำหนักตัวและไขมันสันหลังสูงกว่าสุกรสาวที่เข้าสู่วัยเจริญพันธุ์ในฤดูร้อน (97.4 กก., 11.3 มม.) (P<0.001) ในฤดูร้อน 91% ของสุกรสาวแสดงการเป็นสัดหลังจากเข้าฝูงมาแล้วมากกว่า 30 วัน ซึ่งมีสัดส่วนสูงกว่าฤดูฝน (35.7%) และฤดูหนาว (67.6%) (P<0.001) อย่างมีนัยสำคัญ ผลการวิเคราะห์ฮอร์โมนพบว่าสุกรสาวที่มีการตกไข่ครั้งแรกมี 35.7% (กลุ่ม A) สุกรสาวที่เคยตกไข่มาก่อนแล้วมี 20.6% (กลุ่ม B) และสุกรสาวที่ไม่พบว่าตกไข่มี 44.4% (กลุ่ม C) ในฤดูร้อนสัดส่วนของสุกรกลุ่ม A ต่ำกว่าฤดูฝนและฤดูหนาวอย่างมีนัยสำคัญ (P<0.05) โดยเฉลี่ยสุกรสาวที่มีความหนามันสันหลังสูงเมื่อเข้าฝูง จะมีระยะ EOI สุกรสาวที่มี BF บาง (r = 0.23, P<0.001) อายุ ความหนามันสันหลัง และน้ำหนักตัวเมื่อเป็นสัดไม่มีผลต่อจำนวนลูกสุกรมีชีวิตแรกคลอดและจำนวนลูกสุกรทั้งหมดแรกคลอดต่อครอก ในท้องที่ 1, 2 และ 3 ระยะหย่านมถึงผสมในสุกรท้องแรกมีแนวโน้มสูงขึ้นในสุกรสาวที่เป็นสัดภายใน 10-20 วัน หลังเข้าฝูงเปรียบเทียบกับสุกรสาวที่เป็นสัดหลัง 41 วัน เมื่อเข้าฝูง (5.5 กับ 6.9 วัน; P=0.09) อัตราเข้าคลอดไม่แตกต่างกันระหว่างสุกรกลุ่ม A B และ C (73%, 75% และ 75% ตามลำดับ) สุกรสาวที่ผสมติดจากการผสมครั้งแรกมีน้ำหนักตัว BF และ EOI ไม่ต่างจากสุกรสาวที่ผสมไม่ติด (P>0.05) โดยสรุปสุกรสาวพันธุ์ LY ที่ถูกเลี้ยงภายใต้อากาศร้อนชื้น แสดงการเป็นสัดครั้งแรกเมื่ออายุ 195 วัน น้ำหนัก 106 กก. และความหนามันสันหลัง 13 มม. ประมาณ 20% ของสุกรสาวที่แสดงการเป็นสัดครั้งแรก การตกไข่มาแล้ว จำนวนสุกรสาวที่แสดงการเป็นสัดพร้อมกับตกไข่ต่ำสุดในฤดูร้อนและสุกรสาวที่เข้าฝูงในฤดูร้อนเป็นสัดช้ากว่าฤดูฝนและฤดูหนาว น้ำหนักตัวและความหนามันสันหลังเมื่อเป็นสัดครั้งแรกมีผลน้อยต่อสมรรถภาพทางการสืบพันธุ์

คำสำคัญ: สุกร วัยเจริญพันธุ์ การจัดการ ระบบสืบพันธุ์

Abstract

Project Code: TRG4580021

Project Title: Influence of age at puberty in gilts on their subsequent reproductive performance

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Project Period: July 2002-June2004

The objective of the present study was to investigate puberty attainment in the crossbred Landrace x Yorkshire (LY) gilts reared under tropical conditions. This study was carried out in a 2,400-sows herd for 1-year period. A total of 659 crossbred LY replacement gilts were included. Fecal samples from 214 gilts were samplings to determine fecal progesterone profile around puberty. A solid-phase ^{125}I-radioimmunoassay was used to determine the progesterone concentrations in the faecal extracted. The gilts entered the gilt pool at an average age of 173.5 $\pm$10.7 days, 95.4 $\pm$10 kg body weight and a backfat thickness of 11.8 $\pm$2.5 mm and the average entry-first-observed oestrus interval (EOI) was 22.0 $\pm$ 15 days (range 1-58 days). Both BW and BF were significantly higher in gilts that showed estrus during winter (110.1 kg, 13.9 mm) and rainy (109.8 kg, 13.4 mm) than summer (97.4 kg, 11.3 mm) (P<0.001). Ninety-one percent of the gilts that showed estrus during summer have been in the gilts pool over 30 days, which was significantly higher than rainy (35.7%) and winter (67.6%) (P<0.001). The hormonal profile indicated that gilts that had first ovulation (Group A) was 35.1%, gilts that had been ovulated was 20.6% (Group B) and gilts that had no ovulation at first observed estrus was 44.4% (Group C). During summer the proportion of group A gilts was significantly lower than winter and rainy season (P<0.05). On average, gilts with a thick BF at entry had a longer EOI than gilts with a thin BF at entry (r=0.23, P<0.001). An increase in 1 mm of BF at entry resulted in a 1.4 days increased in EOI. Gilts with a high GR from entry to oestrus had a shorter EOI than gilts with a low GR from entry to oestrus (r=-0.22, P<0.001). Age, BF and body weight at first observed oestrus did not significantly influence subsequent litter size (TB and BA) in first, second and third litters. WSI in primiparous sows tend to be longer when EOI increase from 10-20 days to more than 41 days (5.5 versus 6.9 days, P=0.09). FR did not differ significantly among group A, B and C (73%, 75% and 75%, respectively). BW and BF at first observed oestrus and EOI did not differ between gilts that successfully farrow and those that fail to farrow (P>0.05). In conclusion, LY gilts reared under tropical conditions expressed first standing oestrus at 195 day of age, 106 kg of BW and BF 13.0 mm. About 20% of the first observed estrus gilts have been ovulated. The number of gilts showing estrus and ovulating was lowest during summer. Gilts that enter the herd during summer attain puberty later than during rainy and winter. Body weight and backfat thickness at first observed seem to have minor effects on subsequent reproductive performances.

Keywords: Pig; Puberty; Management; Reproduction

Effect of age, body weight and backfat thickness at first observed estrus on subsequent reproductive performance in crossbred Landrace x Yorkshire gilts

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Abstract

The objective of the present study was to investigate puberty attainment in the crossbred Landrace x Yorkshire (LY) gilts reared under tropical conditions. This study was carried out in a 2,400-sows herd for 1-year period. A total of 659 crossbred LY replacement gilts were included. Fecal samples from 214 gilts were samplings to determine fecal progesterone profile around puberty. A solid-phase ^{125}I-radioimmunoassay was used to determine the progesterone concentrations in the faecal extracted. The gilts entered the gilt pool at an average age of 173.5±10.7 days, 95.4±10 kg body weight and a backfat thickness of 11.8±2.5 mm and the average entry-first-observed oestrus interval (EOI) was 22.0 ± 15 days (range 1-58 days). Both BW and BF were significantly higher in gilts that showed estrus during winter (110.1 kg, 13.9 mm) and rainy (109.8 kg, 13.4 mm) than summer (97.4 kg, 11.3 mm) (P<0.001). Ninety-one percent of the gilts that showed estrus during summer have been in the gilts pool over 30 days, which was significantly higher than rainy (35.7%) and winter (67.6%) (P<0.001). The hormonal profile indicated that gilts that had first ovulation (Group A) was 35.1%, gilts that had been ovulated was 20.6% (Group B) and gilts that had no ovulation at first observed estrus was 44.4% (Group C). During summer the proportion of group A gilts was significantly lower than winter and rainy season (P<0.05). On average, gilts with a thick BF at entry had a longer EOI than gilts with a thin BF at entry (r=0.23, P<0.001). An increase in 1 mm of BF at entry resulted in a 1.4 days increased in EOI. Gilts with a high GR from entry to oestrus had a shorter EOI than gilts with a low GR from entry to oestrus (r=-0.22, P<0.001). Age, BF and body weight at first observed oestrus did not significantly influence subsequent litter size (TB and BA) in first, second and third litters. WSI in primiparous sows tend to be longer when EOI increase from 10-20 days to more than 41 days (5.5 versus 6.9 days, P=0.09). FR did not differ significantly among group A, B and C (73%, 75% and 75%, respectively). BW and BF at first observed oestrus and EOI did not differ between gilts that successfully farrow and those that fail to farrow (P>0.05). In conclusion, LY gilts reared under tropical conditions expressed first standing oestrus at 195 day of age, 106 kg of BW and BF 13.0 mm. About 20% of the first observed estrus gilts have been ovulated. The number of gilts showing estrus and ovulating was lowest during summer. Gilts that enter the herd during summer attain puberty later than during rainy and winter. Body weight and backfat thickness at first observed seem to have minor effects on subsequent reproductive performances.

Keywords: Pig; Puberty; Management; Reproduction

1. Introduction

Pig industry is one of the most important parts for livestock production in Thailand. During the last decade, intensive commercial pig farms have gradually been developed. The pig breeds used most for producing dam line are Landrace and Yorkshire, which mostly are imported from Europe and USA. In general, reproductive performance of the pigs in Thailand was lower than pigs in Europe. The reason might be due to nutrition, climate, disease and/or management. Recent studies indicated that many factors, e.g., sow breed, parity, season, lactation length, mating type as well as some interactions, influence sow reproductive performance (Tantasuparuk et al., 2000; Tummaruk et al., 2000a, b). The impacts of these factors on gilts that were grown up in Thailand as well as in Southeast Asia have not comprehensively

been evaluated. Furthermore, knowledge concerning biological background of pigs, such as age at puberty, under tropical condition and under intensive management system is needed in order to develop proper pig breeding management for the country.

Age at puberty of gilts is defined as the time of first oestrus and ovulation with a continuation of regular oestrous cycles. On average, gilts attain puberty at about 6-7 months of age. Factors influencing puberty attainment and the continuation of oestrus cycle in gilts included the detection of estrus, genetics, season of the year during sexual development, confinement environment, boar exposure, nutrition and disease (Christenson, 1986). Studies have shown that age of gilts at first mating, age at conception as well as age at first farrowing related with subsequent sow reproductive performance and longevity (Schukken et al., 1994; Le Cozler et al., 1998a,b; Koketsu et al., 1999; Tummaruk et al., 2001). A great variation on age at puberty of gilts was observed and factors like breed, season, nutrition and management have been shown to influence age at puberty (Karlbom, 1981; Christenson, 1984; Burnett et al., 1998; Le Cozler et al., 1999; Tummaruk et al., 2000a; Evans and O'Doherty, 2001). However, the impact of these factors varied according to management conditions. In Thailand as well as in Southeast Asia, no comprehensive study on age at puberty of the European breed of gilts has been performed.

In pig, attainment of minimum threshold levels for age, weight and body fat are necessary for puberty onset. It has been reported that about 20% of all pubertal gilts do not show standing oestrus, despite the presence of a boar at their first ovulation (Eliasson, 1989). Age at puberty is reported to be approximately normally distributed (Eliasson et al., 1991). In Swedish Yorkshire, age at puberty was 210.9 days, 118.8 kg live weight and 15.5 mm BF. Karlbom et al. (1982) found that crossbred Landrace x Yorkshire gilts showed first oestrus at 183 days (range 151-211) and body weight of 97 kg (range 73-112). It was found that about 27% of the gilts showed first observed oestrus within 10 day after moving to the breeding unit (Eliasson et al., 1991). Le Cozler et al. (1999) found that gilts received a standard rearing diet (12.3 MJ/kg ME, 18.1% CP and 1 % lysine) fed to ad libitum from 74-180 days of age reached puberty at 198 days, 127 kg body weigt and 17.8 mm BF, whereas restricted feed to 80% of the standard feed resulted in a significantly increased age (203 days), decrease BW (117 kg) and decrease BF (14.7 mm) at puberty. Gilt age at puberty has a relatively high heritability ($h^2 = 0.3$) compared with most other reproductive traits (Rydhmer et al., 1994; Rothschild, 1996). The average age at first oestrus in crossbred L x Y gilts was 185 days, with a mean body weight of 98 kg (Andersson et al., 1982). In France, the average age and weight at first oestrus for French Large White (Yorkshire), French Landrace and their crossbred gilts were 215, 198 and 190 days, and 116, 103 and 98 kg, respectively (Bidanel et al., 1996). To our knowledge, no such scientific data of puberty in crossbred LY gilts have been shown in Thailand.

This study aimed to increase knowledge about puberty attainment in the crossbred Landrace-Yorkshire gilts reared under tropical conditions in an intensive swine production of Thailand. Age, body weight (BW) and backfat thickness (BF) at first observed estrus as well as the fecal progesterone (P_4) profile were investigated. Furthermore, some of the subsequent reproductive performance of these gilts were studied.

2. Materials and Methods

2.1 Animals

This study was carried out in a 2,400-sows herd during September 2002 to August 2003. A total of 659 crossbred LandracexYorkshire (LY) replacement gilts were included. The gilts enter the gilts pool at about 20 week of age. The gilts were kept in an open house with a pen size of 30.42 m^2 (3.9x7.8 m) and a group size of between 15-20 gilts/pen (density 1.5-2.0 m^2/gilt). The oestrus were checked daily using back pressure test with the present of a mature boar by fence line contact. Gilts with vulva symptoms were carefully observed for standing oestrus. The day of standing oestrus for each gilt were recorded. The health in the herds was controlled by the herd veterinarians, which also gave recommendations about the vaccination programme for Parvovirus, Aujesky's disease, Foot and Mouth disease, Swine fever, Atrophic rhinitis and Mycoplasma. The gilts were provided water ad libitum with 2 water nipples per pen and were

manually fed twice a day (about 3 kg of feed/gilt/day). The feed was a corn-soybean-fish based containing 18% cruded protein, 3,250 kcal/kg metabolisable energy (ME) and 0.85% lysine. The indoor temperature and humidity were measured daily at 12.00 AM and the maximum and minimum of both parameters were recorded by a digital thermometer. The average maximum temperature and humidity inside the pig barn during the studies period was 35.2 °C and 83.9% RH (range 27-40.2 °C and 44-97% RH).

2.2. Experimental design

A field trial was performed in the gilts pool of the herd for one-year period. The replacement gilts entering the herd were measured for BW and BF individually first time at entry and second time when the gilts showed first oestrus symptoms. Fecal samples from each gilts were collected weekly and oestrus detection was checked daily. When the gilts shows first oestrus, the fecal samples before and after the heat were checked for P_4 metabolite levels. Gilts were classified according to their hormonal profile, BW, BF and interval from entry to first observed oestrus (EOI). Their reproductive performance were followed up and related with the performance test in the gilts pool.

2.3 Bodyweight measurement

Body weight (BW) was measured in all gilts twice at entry and within a week after standing heat. Since the animals were not weighed every day, growth rate of the gilts between the measurements (GRI), BW at oestrus and growth rate from birth to estrus (GRO) were then calculated using simple estimation models below:

GRI (g/d) = ((2^{nd} – 1^{st} BW measurement)/ period between the measurements (d)) x 1000

BW at oestrus (kg) = 2^{nd} BW measurement – (GRI x period between oestrus and 2^{nd} measurement(d))

GRO (g/d) = ((BW at oestrus – 1.5)/age at oestrus) x 1000

2.4 Backfat thickness measurement

BF was measured twice for each gilts at the same as BW measurement. A-mode ultrasonography was used for the BF measurement. BF was measured at the level of the last rib at about 6-8 cm from mid line in both sides. The average between left and right was calculated and used the BF of the gilts. Adjusted BF at standing heat were calculated using the estimation model below:

Estimated BF at oestrus (mm) = 2^{nd} BF measurement – (((2^{nd} BF –1^{st} BF)/ period between the measurements) x period between oestrus and 2^{nd} measurement(d))

2.5 Fecal samplings and hormonal extraction

In all gilts, feces (10 g) were collected once weekly throughout the study period and the sample was stored at –20 °C until extraction took place. The extraction procedure have been described by Tummaruk et al. (2004). Briefly, one gram of feces was suspended in 10 ml, 0.01 M, phosphate buffer with 0.15 M, NaCl (pH 7.0). The samples were shaken for 12 h at 25 °C, centrifuged at 2700 x g for 15 min and the supernatant was collected and either frozen (-20°C) or immediately used for the assay.

2.6 Fecal progesterone assay

A solid-phase ^{125}I-radioimmunoassay (Coat-A-Count®, Diagnostic Product Corporation, Los Angeles, CA, USA) was used to determine the progesterone concentrations in the faecal extracted

supernatant (Tummaruk et al., 2004). The kit provides a reagent and a tube, coated with antibodies to progesterone. The calibrators represented 0, 0.3, 1.6, 31.8, 63.6 and 127.2 nmol/l. A 0.1-ml aliquot of calibrators, the undiluted faecal extract samples and 1.0 ml of iodinated progesterone (approximately 75000 cpm), were pipetted into the appropriate tube, in duplicate. After 3 h incubation at room temperature, the incubate was removed by simple decantation and each tube was counted for 1 min in a gamma counter. According to the manufacturer's instructions, the P_4 antiserum is highly specific for P_4, with low cross reactivity to other naturally occurring steroids. The sensitivity of the assay was 0.06 nmol/l. The assay procedure followed that shown in the manufacture's manual. Briefly, 100 µl of plasma or the faecal extract was put in tubes coated with P_4 antibody, in duplicate. 1.0 ml of ^{125}I-Progesterone was added to every tube and incubated for 3 hours at room temperature (25 °C). The liquid was removed from all tubes and the tubes were counted for 1 minute in gamma counter.

2.7 Statistical analyses

The statistical analyses were carried out using SAS (SAS, 1989). Analysis of variance was used to analyse litter size (number of piglets born alive (BA) and number of total piglets born per litter (TB)) by using General Linear Model procedure (GLM). The statistical models included effect of parity number, season, group of hormonal profile, age at first observed oestrus and 2-ways interactions. The effect of BF and BW at first observed oestrus were also tested. Due to a high correlation between BF, BW, age at first observed oestrus and EOI, these variables were the tested once at a time and not included in the same model. Seasons were classified as winter (Nov-Feb), summer (Mar-Jun) and rainy (Jul-Oct). Quarter of the year were also used in the model as a seasonal effect for litter size (quarter 1: Jan-Mar, quarter 2: Apr-Jun, quarter 3: Jul-Sep, quarter 4: Oct-Dec). Interval from entry to first observed oestrus were classified as 0-10 days, 11-20 days, 21-30 days, 31-40 days and more than 41 days. Pearson's correlation was used to analyse the relationships between all continuous variables by using PROC CORR. Regression analysis was applied for continuous variables using PROC REG. Farrowing rate was calculated by PROC FREQ. The difference with $P<0.05$ were regarded as statistical significance.

3. Results

3.1 Age, body weight and backfat thickness at first observed oestrus

Age, BW and BF of LY gilts at first observed estrus is shown in Table 1 and Fig. 1, 2, 3. Both BW and BF were significantly higher in gilts that showed estrus during winter (110.1 kg, 13.9 mm) and rainy (109.8 kg, 13.4 mm) than summer (97.4 kg, 11.3 mm) ($P<0.001$). Ninety-one percent of the gilts that showed estrus during summer have been in the gilts pool over 30 days, which was significantly higher than rainy (35.7%) and winter (67.6%) ($P<0.001$).

3.2 Fecal progesterone levels before and after oestrus

The estrous gilts were classified according to fecal P_4 metabolite into 3 groups. Group A were gilts that had a low P_4 metabolite (<20 pmol/g) before estrus and high P_4 metabolite (>20 pmol/g) after estrus. Group B were gilts that had a high P_4 both before and after estrus. Group C were gilts that had a low P_4 both before and after estrus (Table 2). Of these gilts, gilts that had first ovulation (Group A) was 35.1%, gilts that had been ovulated was 20.6% (Group B) and gilts that had no ovulation at first observed estrus was 44.4% (Group C). However, these percentages differed among seasons. During summer the proportion of gilts that showed first estrus at first ovulation was significantly lower than winter and rainy season ($P<0.05$) (Table 2).

3.3 Association between age, body weight and backfat thickness at entry and interval from entry-to-first observed oestrus

The gilts entered the gilt pool at an average age of 173.5±10.7 days, 95.4±10 kg body weight and a backfat thickness of 11.8±2.5 mm and the average entry-first-observed oestrus interval (EOI) was 22.0 ± 15 days (range 1-58 days). During the period from entry-to-first observed oestrus, the gilts gain 1.3 mm of BF (range –5 to 7 mm) and gained 10.8 kg of bodyweight (range –4.2 to 40 kg) and growth 543 g/d. On average, gilts with a thick BF at entry had a longer EOI than gilts with a thin BF at entry (r=0.23, P <0.001). Gilts with a high GR from entry to oestrus had a shorter EOI than gilts with a low GR from entry to oestrus (r=-0.22, P<0.001). Body weight at entry were significantly correlated with BF (r=0.39, P <0.001) and age at entry (r=0.44, P<0.001). Neighter body weight at entry nor age at entry were significantly correlated with EOI (P>0.05). After adjusted for age and/or body weight at entry, BF was still significantly influenced EOI (P<0.001). An increase in 1 mm of BF at entry resulted in a 1.4 days increased in EOI.

3.4 Association between age, body weight and backfat thickness at first observed oestrus and subsequent litter size

Of the gilts that included in the experiment (n=214), the number of piglets born alive per litter (BA) was 9.0 piglets and number of total piglets born per litter (TB) was 9.7 piglets for the first litter. Of these gilts, BA for parity 1, 2 and 3 were 8.9, 9.9 and 9.8 piglets, respectively (P>0.05). In the first 3 parities, farrowing in quarter 1 (Jan-Mar), 2 (Apr-Jun), 3 (Jul-Sep) and 4 (Oct-Dec) of the year resulted in a BA of 9.9, 9.4, 8.8 and 10.2 piglets/litter, respectively. Farrowing in quarter 3 of the year (July-Sep) resulted in a lower BA than farrowing in quarter 4 (Oct-Dec) (P<0.05). Age, BF and body weight at first observed oestrus did not significantly influence subsequent litter size (TB and BA) in first, second and third litters.

3.5 Relationship between entry-to-oestrus interval and subsequent reproductive performance

EOI was not significantly influence both BA and TB (P>0.05). WSI in primiparous sows tend to be longer when EOI increase from 10-20 days to more than 41 days (5.5 versus 6.9 days, P=0.09). Farrowing rate of the gilts was on average 74.4%. FR did not differ significantly among group A, B and C (73%, 75% and 75%, respectively). BW and BF at first observed oestrus and EOI did not differ between gilts that successfully farrow and those that fail to farrow (P>0.05).

4. Discussion

Previous studies have shown that puberty attainment in pig depended on a minimum threshold of age, body weight and body fat content (Le Cozler et al., 1998b, 1999). In the present study, the gilts attain puberty at about 195 days, 106 kg BW and 13.0 mm BF, which is within a normal range compared to previous studies in the same breed of gilts (Andersson, 1982; Bidanel et al., 1996). In Sweden, however, Karlbom et al. (1982) found that crossbred Landrace x Yorkshire gilts showed first oestrus at 183 days (range 151-211) and body weight of 97 kg (range 73-112), which is slightly younger and smaller at puberty. A large variation of these parameters among gilts that were observed indicated that there is a possibility to improve these traits in the gilt population. Factors causing a big variation in the present study are, for instance, season of the year that the gilts reach puberty. High ambient temperature and/or humidity might play an important role for this trait. Grieger et al. (1986) found that crossbred gilts reared outdoor reach puberty at 202 days, which is significantly earlier than those reared in confinement environment (six gilts per pen 2.4x4.3 m), which attain puberty at 224 days. Gilts exposed to high concentration of ammonia (21 ppm NH_3) attain puberty later than gilts exposed to low concentration of ammonia (5 ppm NH_3) (Malayer et al., 1987). Gilts reared in a complete continuous darkness room reached puberty later and at heavier weight than gilts in 18 h/day of cool white fluorescent light or 9 h/day of natural light (103.3, 90.3 and 94.8 kg, 193.4, 175.6 and 177.1 days respectively) (Ntunde et al., 1979).

Practically, in Thailand farmer face to many problems such as low BW at puberty or old age at puberty, which make a tricky situations for mating management in gilts. More studies need to be performed to minimize any problems around puberty.

In the present study, some reproductive traits such as litter size, WSI and FR in the gilts were followed up subsequently for 1 year. It was found that BW, BF and age measured at puberty have a minor influence on subsequent reproductive performance. Once the gilts attained puberty were decided to be mated, the relationship between pubertal parameters and their performance was not significant. Studies have shown that major factors influencing subsequent reproductive performance in gilts included the semen quality, the insemination technique and the gilts and its environment. For instance, over feeding after insemination increased embryonic loss (den Hartog and Vesseur, 1994). Gilts exposed to high ambient temperature post breeding and during pregnancy reduced embryonic survival and pregnancy rate (Omtvedt et al., 1971). The embryos were most susceptible to heat stress during 8-16 day post breeding, which is the placentation period (Omtvedt et al., 1971). Tummaruk et al. (2004) found that the inferior litter size of gilts during some period of the year in Thailand was correlated with a rising in ambient temperature and humidity during pregnancy. The lowest litter size was observed in sows farrowed in August, which were sows that have been mated since April (the hottest period in Thailand). In the present study, factors between puberty and farrowing was not controlled. These might influence the performance of the gilts. Data on culling time and cause of culling might be needed to be further analysed.

Karlbom et al. (1982) found that the mean daily progesterone levels varied between 32-329 pmol/l during the 30-day period before first oestrus, with a highest individual value of 874 pmol/l. Study on fecal progesterone assayed around puberty has been studied (Tummaruk et al., 2004). In the present study a large variation of P_4 before and after puberty was observed. The animals were classified according to the hormonal profiles to 3 groups (A, B and C). Surprisingly, group C was found most. These gilts showed sign of oestrus but the P4 did not increase after the oestrus. This might be due to many events such as false oestrus detection, standing oestrus without ovulation, irregular oestrus symptoms due to ovarian cysts and mycotoxin (zearalenone). However, using fecal progesterone assay is a good non-invasive and non stressful technique for determine ovarian function in gilts around puberty. Eliasson (1989) carefully checked for oestrus symptoms of 369 gilts and still found 6 oestrus gilts that had progesterone level in plasma at 12 days after oestrus below 7 nmol/l. This might also partly explain the observation of group C in the present study.

In the present study, about 20% of the gilts have been ovulated before first observed oestrus. This is in accordance with Eliasson (1989) who found that 20% of gilts did not show standing oestrus at first cycle. In addition, Einarsson et al. (1978) followed the ovarian activity in prepubertal and pubertal gilts by estimating the peripheral blood level of P_4 every 10^{th} day. The hormone determination indicated that 7 out of 39 gilts (18%) had formed corpora lutea before clinical sign of heat was observed. These studies along with the present observation indicated that under field condition approximately 20% of the first observed oestrus gilts have been ovulated. Subsequent reproductive performance as well as oestrus symptoms of thes gilts are of interest for further studies.

In the present study, backfat thickness at entry significantly correlated with EOI. It was demonstrated that BF at 90 kg body weight was negatively correlated with age at puberty whereas BF at puberty had no influence on puberty attainment (Eliasson et al., 1991). An increase in BF of one mm at 90 kg lowered age at puberty by 1.6 days (Eliasson et al., 1991). Furthermore, Eliasson (1991) found that gilts with low backfat thickness have a less intense and shorter duration of reddening and swelling of the vulva at puberty than gilts with high backfat thickness.

Lyvers-Peffer and Rozeboom (2001) demonstrated that feeding the prepubertal gilts with a high fiber diet to slow growth for 3-5 week enhanced lactation feed intake during the first litter and tend to increase piglets weaning weight. In the present study, variation on growth performance of the gilts from entry (20 weeks of age) to first observed oestrus was found. The gilts with a lower growth rate during this period had a prolong EOI. Gilts with a low BF at entry had a significantly higher growth rate from entry to oestrus. Rinaldo et al. (2000) demonstrated that tropical climate (27.3 °C, 82% RH) reduced about 13% of feed intake and growth rate of pig during 35-90 kg compared with control ambient temperature (24.6 °C,