高・中・低生産性農場における四つに細分化した母豚の生涯非生産日数と生涯繁殖成績との関連性

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Original Article

An Assessment of Four Components of Sow Lifetime Nonproductive Days and Lifetime Performance on High-, Intermediate- and Low-performance Commercial Breeding Farms

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Summary

We have measured the four lifetime components of sow nonproductive days (NPD) and proportions of the four lifetime NPD components by farm productivity groups, by using 44,720 lifetime records on 101 Japanese commercial farms. Lifetime NPD were divided into four components : first-mating-to-conception interval at parity 0 (FMCI), lifetime weaning-to-first-mating interval (WMI), lifetime sow first-mating-to-conception interval (MCI), and last weaning-to-culling interval (WCI). Three farm productivity groups were formed on the basis of the upper and lower 25th percentiles of pigs weaned per mated female per year : high-, intermediate-, or low-performing farms. Mean lifetime NPD (± SEM) was 87.4 ± 0.31 days. Mean FMCI, lifetime WMI, lifetime MCI and WCI were 5.8 ± 0.10, 27.4 ± 0.11, 14.9 ± 0.16, and 39.3 ± 0.23 days, respectively, and comprising 6.6, 31.4, 17.0, and 45.0%, respectively of lifetime NPD. High-performing farms had lower lifetime NPD and four NPD components than low-performing farms ($P<0.05$), although there were no differences between the farm groups in sow life days. On high-performing farms, the relative contributions of the NPD components in FMCI, lifetime MCI, and WCI were 1.9 to 5.4% lower than those on low-performing farms ($P<0.05$). In order to improve sow lifetime efficiency it is important to decrease the duration of each NPD component. Additionally, the relative contribution of WCI is the largest of the four NPD components, so controlling this is especially critical.

Keywords : Lifetime efficiency, Management, Nonproductive days, Removal, Swine

Introduction

One of the most critical factors for determining pig farm productivity, measured by pigs weaned per mated female per year (PWMFY), is nonproductive female day (NPD)[13,17]. Decreasing NPD in any parity results in increased lifetime productivity of sows, improved farm productivity, and increased profitability[9,11]. Additionally, lifetime NPD of sows accounts for 20.7% of their herd life[10]. Lifetime NPD accumulation is negatively associated with reproductive efficiency[11].

The lifetime NPD of sows is comprised of four components[3] : first-mating-to-conception interval at parity 0 (FMCI at parity 0), weaning-to-first-mating interval in lifetime (lifetime WMI), sow first-mating-to-conception interval in lifetime (lifetime MCI), and weaning-to-culling interval (WCI). The number of days in each NPD component and its proportion of lifetime NPD vary between parities at culling because lifetime NPD accumulates with increased parity of sows. However, no study has measured the four lifetime NPD components in individual sows by the parity at culling or their relative contributions to lifetime NPD. In order to control lifetime NPD, it is necessary to measure each NPD component by sow life stages. Additionally, it has been suggested that NPD component measurements on high-performing farms, based on PWMFY, could be used as benchmarks for swine producers and veterinarians[8]. Therefore, the objectives of the present study were to measure the four lifetime NPD component of sows and their relative contributions to lifetime NPD by farm productivity groups on commercial breeding farms.

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Materials and Methods

Data

Producers located in Japan using recording software (PigCHAMP Inc., Ames, IA, U.S.A.), numbering approximately 130 farms, were requested to mail their data files to Meiji University each time they renewed the yearly maintenance contract. By August 31, 2008, 120 commercial farm producers had mailed their data files to the university, and the present study used data from 101 of these breeding farms that had accurate records of birth dates of female pigs. The data analyzed were a subset of a larger dataset from an earlier study[14]. Mean (±SEM) and median herd size were 378±50.4 and 244 females, respectively, with a range between 25 and 3,304 females.

The original dataset included lifetime records of 63,990 females born from 2001 to 2004 on 101 farms. Excluded from the present study were 7,493 non-culled animals, 2,784 that were still alive when the data were collected, 6,688 culled gilts that did not have any litters, and 2,305 females that had either inaccurate lifetime records or incomplete parity records. Hence, 44,720 sows culled at parity 1 or later were included in the present study.

Females were mainly crossbreds between Landrace and Large White, which were reproduced within the farm, or gilt replacements purchased from domestic or international breeding companies. Breeding stock for these breeds was originally imported from U.S.A. or Europe.

Definitions and category

Lifetime NPD is defined as the number of days when females are neither gestating nor lactating during their reproductive herd life[12]. The reproductive herd life was defined as the days from the date that the gilts were first mated to culling. Lifetime NPD consisted of four components : FMCI (first-mating-to-conception interval) at parity 0, lifetime WMI (weaning-to-first-mating interval), lifetime MCI (sow first-mating-to-conception interval), and WCI (weaning-to-culling interval in parity at culling). The FMCI at parity 0 was defined as the interval between the first mating date from entry to farm and the date of mating and conception. The date of mating and conception was defined as the date of first mating of a female followed by the subsequent farrowing[12]. Lifetime WMI and lifetime MCI were calculated by the summing of each interval. The WCI was defined as the number of days from weaning to culling in parity at culling. Entry-to-first-mating interval at parity 0 was excluded from components of lifetime NPD, because the interval included management discretion in establishing time of first mating relative to time of entry into the farm[11]. Parity 6 includes data of parity 7 or high.

Farm reproductive productivity was measured as PWMFY over five years from 2002 to 2006[3]. Three farm groups were built on the basis of the middle 50th percentile and the highest and the lowest 25th percentiles of PWMFY : high-performing farms ($\geq$ 23.6 pigs ; 26 farms), intermediate-performing farms (20.2 to 23.5 pigs ; 49 farms), and low-performing farms (<20.2 pigs ; 26 farms). The PWMFY is a farm based measurement for females fed on a farm from first mating as a gilt to culling.

Statistical analysis

All statistical analyses were performed with SAS software, version 9.1 (SAS Inst. Inc., Cary, NC). A multilevel analysis was used to account for the hierarchic structure of the individual females within the farm, by using a farm at level 2 and an individual record at level 1[15]. A linear mixed-effects model was used to compare performance measurements by using the MIXED procedure with a Tukey-Kramer multiple comparisons test. Model 1 was built to compare NPD measurements between farm groups and groups of parity at culling. The dependent variable was lifetime NPD and the four components of lifetime NPD, and the independent variables were farm group, groups of parity at culling, and the interaction between the farm group and parity at culling. A square root transformation was performed on the NPD components used as a dependent variable, and after analysis, the data were back-transformed to present the results. Model 2 was constructed to compare differences in the relative contributions of the four NPD components in lifetime NPD between three farm groups. The dependent variable was the relative proportions of four NPD components in lifetime NPD, and the independent variable was the farm group. In these Models, herd size was also included as a fixed effect. In addition, farm, birth year and an interaction between farm and birth year were included as a random intercept.

Results

Mean values of lifetime NPD, FMCI at parity 0, lifetime WMI, lifetime MCI, and WCI in the sample of 44,720 sows are shown in Table 1. High-performing farms had shorter lifetime NPD and NPD components than low-performing farms ($P<0.05$), but had similar lifetime WMI to intermediate-performing farms. Intermediate-performing farms had shorter FMCI at parity 0, lifetime WMI, and lifetime MCI than low-performing farms ($P<0.05$), but had similar WCI to low-performing farms. There were no differences between farm groups in herd life days or female life days.

Lifetime NPD increased with parity at culling, up to parity 5 ($P<0.05$; Table 2), but sows culled in parity $\geq$ 6 had shorter lifetime NPD than those culled in parity 3 to 5 ($P<0.05$). Sows culled in parity $\geq$ 6 (4.5±0.12 days) also had shorter FMCI at parity 0 than the other sows ($P<0.05$) ; mean values (±SEM) in sows culled at parity 1, 2, 3, 4, 5, and $\geq$ 6 were 7.4±0.34, 7.0±0.40, 7.1±0.41, 6.7±0.36, 6.8±0.36, and 4.5±0.12 days, respectively. As the number of parity at culling increased from parity 2 to $\geq$ 6, lifetime WMI and lifetime MCI increased from 10.6 to 38.7 days and from 7.5 to 18.5 days, respectively ($P<0.05$; Table 2). However, WCI decreased as the parity increased from 1 to $\geq$ 6 ($P<0.05$).

Table 1 Comparisons of lifetime nonproductive days (NPD), four lifetime NPD components, and lifetime measurements by farm productivity group

	Mean ± SEM	Farm productivity group[2]		
		High	Intermediate	Low
Number of sows	44,720	14,499	20,324	9,897
Lifetime NPD, days	87.4 ± 0.31	69.8 ± 0.40^{z}	92.8 ± 0.47^{y}	102.1 ± 0.76^{x}
First-mating-to-conception interval at parity 0, days	5.8 ± 0.10	3.7 ± 0.13^{z}	6.5 ± 0.17^{y}	7.3 ± 0.26^{x}
Weaning-to-first-mating interval in lifetime[1], days	27.4 ± 0.11	26.5 ± 0.15^{y}	27.4 ± 0.16^{y}	27.7 ± 0.26^{x}
Sow first-mating-to-conception interval in lifetime[1], days	14.9 ± 0.16	9.3 ± 0.20^{z}	16.9 ± 0.26^{y}	20.1 ± 0.42^{x}
Weaning-to-culling interval, days	39.3 ± 0.23	30.3 ± 0.32^{y}	42.0 ± 0.36^{x}	47.0 ± 0.58^{x}
Proportion of herd life days that were NPD, %	11.2 ± 0.06	8.7 ± 0.08^{z}	11.8 ± 0.09^{y}	13.8 ± 0.13^{x}
Herd life days	778.9 ± 1.62	799.0 ± 2.59	783.4 ± 2.45	740.3 ± 3.68
Female life days	1026.1 ± 1.61	1035.9 ± 2.58	1030.3 ± 2.44	1002.9 ± 3.67
Parity at culling	4.5 ± 0.01	4.8 ± 0.01^{x}	4.5 ± 0.01^{y}	4.1 ± 0.02^{z}

$^{x-z}$ Values within a row without a common superscript are different (z < y < x, P < 0.05).

[1] Number of sows on all farm, high-performing farms, intermediate-performing farms, and low-performing farms were 39,114, 13,096, 17,705, and 8,313, respectively.

[2] The three farm groups were categorized on the basis of the upper and lower 25th percentiles of pigs weaned per mated female per year, averaged over five years : high-performing farms (≥23.6 pigs; High), intermediate-performing farms (20.2 to 23.5 pigs ; Intermediate), and low-performing farms (<20.2 pigs ; Low).

Two-way interactions between farm groups and parity at culling were found in lifetime NPD, lifetime WMI, lifetime MCI, and WCI (P<0.05 ; Table 2). In the high-performing farm group, sows culled at parity 1 and ≥ 6 had equally the shortest lifetime NPD between parity groups (P<0.05). In contrast, in intermediate- and low-performing farm groups, the shortest lifetime NPD was for sows culled in parity 1 (P<0.05) ; those culled in parity ≥ 6 had lifetime NPD similar to parity 2 or higher. In sows culled at parity 2, no differences were found between the farm groups for lifetime WMI or lifetime MCI. In other parities, high-performing farms had shorter lifetime WMI and MCI than low-performing farms (P<0.05). In high- and intermediate-performing farm groups, sows culled at parity 1 or 2 had longer WCI than those culled at parity 3 or 4 (P<0.05). In contrast, there was no difference in WCI in sows culled at parity 1 to 4 in the low-performing farm group.

The relative contributions of FMCI at parity 0, lifetime WMI, lifetime MCI, and WCI to lifetime NPD are presented in Table 3. In high-performing farms the relative contributions of FMCI at parity 0 and WCI were lower than on intermediate- and low-performing farms, but lifetime WMI was higher (P<0.05). The relative contributions of lifetime MCI in high-performing farms was lower than on low-performing farms (P<0.05), but was similar to intermediate-performing farms.

Discussion

The values for lifetime NPD and its four NPD components on high-performing farms provide feasible farm reproductive efficiency targets for swine breeding farms. In our study high-performing farms had 30 days shorter lifetime NPD than low-performing farms, although there were no differences between the farm groups in herd life days and female life days. Therefore, high-performing farms appeared to use herd life days of sows more efficiently than the other two farm performance groups.

The present study showed that lifetime NPD accumulated from 72.0 to 104.7 days with increased parity at culling. However, it was surprising that lifetime NPD in sows culled at parity ≥ 6 were 10 to 21 days shorter than those at parity 3 to 5 in all three farm groups. Additionally, sows culled at parity ≥ 6 on high-performing farms had lifetime NPD similar to those culled at parity 1. This is because most sows culled at parity ≥ 6 are preplanned culling, but those culled at low- or mid-parity are involuntary one[4]. Furthermore, high-performing farms analyzed in the present study appeared to impose strict culling policies on sows showing no heat or return to service[14]. In particular, WCI accounts for approximately 50% of lifetime NPD, so it is impera-

Table 2 Interactions between farm productivity group and parity at culling for lifetime nonproductive days (NPD) and three NPD components

Parity at culling	n	Mean ± SEM	Farm productivity group[1] High	Intermediate	Low
			Lifetime NPD, days		
1	5,606	72.0 ± 0.85^{d}	63.4 ± 1.42^{cy}	74.4 ± 1.27^{dx}	75.5 ± 1.75^{dx}
2	3,793	87.6 ± 1.16^{c}	74.3 ± 1.80^{by}	91.8 ± 1.73^{cx}	91.5 ± 2.39^{cx}
3	3,728	98.0 ± 1.20^{b}	80.2 ± 1.85^{az}	99.6 ± 1.77^{by}	111.7 ± 2.57^{ax}
4	4,031	103.2 ± 1.15^{a}	84.9 ± 1.68^{az}	107.8 ± 1.69^{ay}	117.6 ± 2.69^{ax}
5	4,714	104.7 ± 1.06^{a}	84.9 ± 1.45^{az}	110.8 ± 1.63^{ay}	119.0 ± 2.45^{ax}
≥6	22,848	83.0 ± 0.38^{c}	64.6 ± 0.44^{cz}	90.0 ± 0.60^{cy}	104.6 ± 1.07^{bx}
			Weaning-to-first-mating interval in lifetime, days		
2	3,793	10.6 ± 0.23^{e}	8.6 ± 0.32^{e}	10.7 ± 0.34^{e}	11.9 ± 0.50^{e}
3	3,728	18.2 ± 0.29^{d}	15.6 ± 0.44^{dy}	17.8 ± 0.40^{dxy}	21.4 ± 0.68^{dx}
4	4,031	23.8 ± 0.30^{c}	20.3 ± 0.36^{cy}	24.6 ± 0.46^{cxy}	26.6 ± 0.74^{cx}
5	4,714	29.3 ± 0.30^{b}	25.6 ± 0.36^{by}	30.3 ± 0.48^{bxy}	32.2 ± 0.72^{bx}
≥6	22,848	38.7 ± 0.13^{a}	34.8 ± 0.16^{ay}	40.1 ± 0.20^{axy}	43.3 ± 0.35^{ax}
			Sow first-mating-to-conception interval in lifetime, days		
2	3,793	7.5 ± 0.41^{d}	4.5 ± 0.57^{b}	8.2 ± 0.63^{c}	8.6 ± 0.85^{d}
3	3,728	13.8 ± 0.54^{c}	9.6 ± 0.79^{ay}	13.2 ± 0.78^{by}	18.7 ± 1.21^{cx}
4	4,031	16.9 ± 0.59^{b}	10.9 ± 0.79^{ay}	17.9 ± 0.90^{ay}	22.5 ± 1.43^{bcx}
5	4,714	20.1 ± 0.62^{a}	13.6 ± 0.81^{az}	21.4 ± 0.96^{ay}	26.2 ± 1.48^{abx}
≥6	22,848	18.5 ± 0.25^{a}	10.3 ± 0.27^{az}	21.3 ± 0.39^{ay}	29.0 ± 0.73^{ax}
			Weaning-to-culling interval, days		
1	5,606	64.6 ± 0.78^{a}	58.1 ± 1.30^{ay}	66.9 ± 1.16^{ax}	66.5 ± 1.60^{ax}
2	3,793	62.5 ± 0.95^{a}	56.5 ± 1.55^{ay}	65.6 ± 1.44^{ax}	62.3 ± 1.88^{ax}
3	3,728	58.9 ± 0.94^{b}	51.3 ± 1.48^{by}	60.6 ± 1.40^{bx}	63.3 ± 1.98^{ax}
4	4,031	55.8 ± 0.86^{c}	48.7 ± 1.28^{by}	57.6 ± 1.27^{bx}	61.2 ± 2.02^{ax}
5	4,714	48.5 ± 0.74^{d}	40.8 ± 1.08^{cy}	51.7 ± 1.12^{cx}	52.2 ± 1.72^{bx}
≥6	22,848	21.3 ± 0.22^{e}	16.5 ± 0.27^{dy}	23.3 ± 0.35^{dx}	26.5 ± 0.64^{cx}

[a–e] Values within a column without a common superscript are different (e<d<c<b<a, $P<0.05$).
[x–z] Values within a row without a common superscript are different (z<y<x, $P<0.05$).
[1] The three farm groups were categorized on the basis of the upper and lower 25th percentiles of pigs weaned per mated female per year, averaged over five years : high-performing farms (≥23.6 pigs ; High), intermediate-performing farms (20.2 to 23.5 pigs ; Intermediate), and low-performing farms (< 20.2 pigs ; Low).

tive for producers to measure WCI on their farms and to follow a strict culling policy in order to reduce NPD and increase farm reproductive productivity[14].

The present study showed lifetime WMI accumulates as the parity at farrowing increases, because sows normally have a post-weaning anestrus period of 4 to 6 days at each parity[5]. However, high-performing farms had shorter lifetime WMI for sows in parity 3 or later than those on intermediate- and low-performing farms. Management practices such as extended lactation length, increasing feed intake during lactation, and early and accurate pregnancy detection[6,7] can be effective for decreasing WMI and increasing farrowing percentage, and also decreasing reservice interval and MCI.

Shorter FMCI at parity 0 in sows culled at parity ≥ 6 than in sows culled at other parities indicates that these high longevity sows experienced fewer reservice occurrences than the other sows. The mean FMCI of 5.8 days at parity 0 was shorter than the other NPD components, but even so it should not be ignored because minimizing the FMCI component can result in increased lifetime efficiency to some degree. The estrus behavior of gilts, such as estrus duration or timing of ovulation, is different from that of sows[1], therefore specific management practices should be

Table 3 Comparisons of percentage contributions of four components of lifetime nonproductive days (NPD) to total NPD by farm productivity group

Lifetime NPD components	All farms	Farm productivity group[2] High	Intermediate	Low
Number of sows	44,720	14,499	20,324	9,897
FMCI, %	6.6±0.07	5.3±0.11[z]	7.0±0.11[y]	7.2±0.16[x]
Lifetime WMI[1], %	31.4±0.15	38.0±0.27[x]	29.5±0.23[y]	27.1±0.32[z]
Lifetime MCI, %	17.0±0.10	13.3±0.17[y]	18.2±0.16[xy]	19.7±0.23[x]
WCI, %	45.0±0.16	43.4±0.27[z]	45.3±0.24[y]	46.0±0.36[x]

FMCI : First-mating-to-conception interval at parity 0, lifetime WMI : Weaning-to-first-mating interval in lifetime, lifetime MCI : Sow first-mating-to-conception interval in lifetime, WCI : Weaning-to-culling interval

[x–z] Values within a row without a common superscript are different (z<y<x, P<0.05).

[1] Number of sows on all farm, high-performing farms, intermediate-performing farms, and low-performing farms were 39,114, 13,096, 17,705, and 8,313, respectively.

[2] The three farm groups were categorized on the basis of the upper and lower 25th percentiles of pigs weaned per mated female per year, averaged over five years: high-performing farms (≥23.6 pigs ; High), intermediate-performing farms (20.2 to 23.5 pigs ; Intermediate), and low-performing farms (<20.2 pigs ; Low).

considered that will improve efficiency of gilt mating. Suitable management practices to increase the farrowing percentage for gilts are to detect estrus accurately by using a matured boar[6], and to perform multiple matings during an estrus period[16, 18].

The present study did not include entry-to-mating interval of gilts as an NPD component because gilt age at herd entry varies between farms due to different isolation and acclimation practices in order to minimize exposure to specific diseases[2]. However, a prolonged age at first mating would decrease lifetime profitability[11].

In conclusion, in order to improve farm reproductive efficiency it is important to decrease the duration of each NPD component in herd life. In addition, the weaning to culling interval is the largest of the four NPD components, so controlling this is especially critical to reduce NPD.

As an observational study, the limitation of the present study is that nutrition, environment, genotype, herd health and an occurrence of infectious diseases were not taken into account in the analyses. Even with such limitations, this study provides swine producers and veterinarians with valuable information on the measurements of four components of lifetime NPD of sows to use in their practices and production.

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References

1) Almeida, F.R.C.L., Novak, S. and Foxcroft, G.R. : The time of ovulation in relation to estrus duration in gilts. Theriogenology, **53**, 1389–1396, 2000.

2) Dee, S.D., Joo, H.S. and Pijoan, C. : Controlling the spread of PRRSV in the breeding herd through management of the gilt pool. Swine Health Prod., **3**, 64–69, 1995.

3) Dial, G.D., et al. : Reproductive failure : differential diagnosis. Pages 88–137 in Diseases of swine. 7th ed. A.D. Leman, B.W. Straw, W.L. Mengeling, S. D'Allaire, and D.J. Taylor, ed. Iowa State Univ. Press, Ames, 1992.

4) Engblom, L., et al. : Sow removal in Swedish commercial herds. Livest. Sci., **106**, 76–86, 2007.

5) Hoshino, Y. and Koketsu, Y. : A repeatability assessment of sows mated 4–6 days after weaning in breeding herds. Anim. Reprod. Sci., **108**, 22–28, 2008.

6) Knox, R.V., et al. : Effect of housing system and boar exposure on estrus expression in weaned sows. J. Anim. Sci., **82**, 3088–3093, 2004.

7) Koketsu, Y. and Dial, G.D. : Factors associated with prolonged weaning-to-mating interval among sows on farms that wean pigs early. J. Am. Vet. Med. Assoc., **211**, 894–898, 1997.

8) Koketsu, Y. : Six component intervals of nonproductive days

by breeding-female pigs on commercial farms. J. Anim. Sci., **83**, 1406–1412, 2005.

9) Koketsu, Y. and Sasaki, Y. : By-parity nonproductive female days in commercial swine herds. J. Vet. Med. Sci., **71**, 263–267, 2009.

10) Lucia, T., et al. : Estimation of lifetime productivity of female swine. J. Am. Vet. Med. Assoc., **214**, 1056–1059, 1999.

11) Lucia, T., Dial, G.D. and Marsh, W.E. : Lifetime reproductive and financial performance of female swine. J. Am. Vet. Med. Assoc., **216**, 1802–1809, 2000.

12) PigCHAMP, PigCHAMP Reports Manual. University of Minnesota, St. Paul ; 1996.

13) Polson, D., Dial, G. and Marsh, W. : A biological and financial characterization of nonproductive days. Prev. Vet. Med., **16**, 51–53, 1990.

14) Sasaki, Y. and Koketsu, Y. : Culling intervals and culling risks in four stages of the reproductive life of first service and reserviced female pigs in commercial herds. Theriogenology, **73**, 587–594, 2010.

15) Singer, J.D. : Using SAS Proc Mixed to fit multilevel models, hierarchical models, and individual growth models. J. Educ. Behav. Stat., **23**, 323–355, 1998.

16) Takai, Y. and Koketsu, Y. : Double and triple matings associated with reproductive performance in first-serviced and reserviced female pigs in commercial herds. J. Vet. Med. Sci., **71**, 635–639, 2009.

17) Wilson, M.R., et al. : A survey of productivity and its component interrelationships in Canadian swine herds. J. Anim. Sci., **62**, 576–582, 1986.

18) Xue, J.L., et al. : Effect of mating frequency and weaning-to-mating interval on sow reproductive performance. J. Swine Health Prod., **6**, 157–162, 1998

原 著

高・中・低生産性農場における四つに細分化した母豚の生涯非生産日数と生涯繁殖成績との関連性

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要旨

本研究の目的は，四つに細分化した母豚の生涯非生産日数（NPD）とその日数割合を農場生産性グループ間で比較することとした。本研究では，101 農場における 44,720 頭の雌豚における生涯記録を用いた。生涯 NPD は，出生後初交配から受胎までの日数（FMCI），生涯における離乳後初回交配日数（WMI），生涯における初回交配から受胎までの日数（MCI），淘汰産次における離乳から淘汰までの日数（WCI）の四つに細分化した。農場は，年間種付け雌豚当たり離乳子豚数の上位と下位 25% で，高生産性農場，中生産性農場および低生産性農場に分類した。生涯 NPD の平均（±SEM）は 87.4±0.31 日であった。FMCI，生涯 WMI，生涯 MCI および WCI の平均日数は，それぞれ 5.8±0.10 日，27.4±0.11 日，14.9±0.16 日および 39.3±0.23 日であり，日数割合はそれぞれ 6.6%，31.4%，17.0% および 45.0% であった。農場生産性グループ間で生涯生存日数に差は見られなかったが，高生産性農場は生涯 NPD および細分化した四つの NPD が低生産性農場よりも短かった（$P<0.05$）。高生産性農場では，低生産性農場よりも FMCI，生涯 MCI および WCI の日数割合が 1.9% から 5.4% 低かった（$P<0.05$）。母豚の生涯繁殖効率を改善するために，各々の NPD の日数を減らすことが重要である。また，WCI は生涯 NPD の中で最も大きな割合を占めているため，この日数をコントロールすることは重要である。

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