Environmental and Breed Factors Associated with Lifetime and Per Year Productivity of Sows in A Commercial Farm in Michoacan, Mexico

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Abstract
The objective of this study was to determine the effects of some environmental and breed group factors on lifetime and per year productivity of sows. A retrospective study was carried out from 1998 to 2007 using information of a production system with 2,400 sows, in La Piedad, Michoacan, Mexico. Data from 6,063 sows belonging to the breed groups PIC Camborough 22, Yorkshire (Y), F_1 Landrace (L) x Y (F_1 LY) and 3/4Y1/4Lwere used. The response variables were the number of pigs born alive per sow per year (PBY) or per productive lifetime (PBL), number of pigs weaned per year (PWY) or per productive lifetime (PWL), kg of pigs weaned per sow per year (KWY), kg of pigs weaned per sow per lifetime (KWL) and productive lifetime (PLT) of sows. The statistical model included the fixed effect of year of first farrowing (1998-2007), season of first farrowing (spring, summer, fall, winter), breed group of the sow, number of pigs born alive at first farrowing (<7, 7-8, 9-10, >10 pigs) and year by season interaction. Means and standard deviations estimated for PBY, PWY, KPY, PBL, PWL, KWL and PLT were 21.4±3.71 pigs, 18.2±4.04 pigs, 107.5±25.8 kg, 48.3±22.7 pigs, 41.4±3.71 kg, 243.7±122.9 kg and 805.6±338.8 days, respectively. All factors studied had effect on all traits ($P < 0.05$), except, breed group on PBY, and season on PWY and KWL. The interaction of year by season was not significant only for PBY. Sows farrowing from 2005 to 2007 and in the fall season had the poorest performance. The best performance per year or productive lifetime corresponded to the 1/4L3/4Y breed group, except for PBY where no differences were found. Also, the 1/4L3/4Y sows stayed longer in the herd. The sows with the smallest litter size at first parity (≤ 6 piglets) had the worst performance.

Keywords: pigs born per year; pigs weaned per year; pigs born per lifetime; pigs weaned per lifetime; kilograms of pigs weaned per year; kilograms of pigs weaned per lifetime.

1. Introduction

The numbers of pigs a sow can produce annually or per productive lifetime are normal measures of production efficiency in a herd. A sow should wean at least 30 piglets per year, or 60 per lifetime [1]. The United State herd runs about 35 pigs during the sow productive lifetime; however, the National Pork Board (NPB) has established the goal to increase in 30% the total number of quality pigs a sow weans from breeding to culling. In114 breeding herds in Japan, Koketsu et al [2]reported that the 10th percentile of farms produced 18.9 pigs weaned per mated female per year and 34 lifetime pigs born alive, whereas the highest 90thpercentile of farms produce 24.8 and 58 pigs, respectively. In Spain, the least efficient farms weaned 14.9 pigs per sow per year and the best farms weaned 24.6 pigs per sow per year [3] and in Venezuela, the effect of month of first farrowing and breed group on the number of pigs

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weaned per year was observed. In Mexico, there is no information on sow productivity per year or productive lifetime. The productive lifetime of a sow is also a very important trait that determines the profitability of a farm, because it affects the costs of production.

Farm differences exist in sow productivity (per year or per lifetime)associated to geographical location and herd management [2] and within herd due tonon-genetics factors such as season of the year, reasons of culling [5]; litter size and age at first farrowing of the sows [6] and genetic factors such as breed [4,6]. Knowing the farm productive parameters and the factors affecting them is important to establish better herd practices in order to improve sow and herd productivity.

The objective of this study was to estimate the lifetime and per year productivity of sows and to determine the effect of some factors in a commercial farm system located in Michoacán, Mexico.

2. Materials and methods

Localization and climate

A retrospective study was carried out from 1999 to 2008 using the information of a commercial pig farm system, with approximately 2,400 sows, in La Piedad, Michoacan, Mexico. The farm was located at20° 03′ north and 102° 01’ west, at 1,675 meters above sea level [7]. The climate of the region is temperate, with average temperature of 19.6°C (2-35°C), warm summers, and rainfall of 784 mm, mainly from June to September. Pig production is a very important activity in “LaPiedad region”. Sows in the farm belonged to the PIC, Yorkshire (Y), Y x Landrace (F1YL) and ¾YxL breed groups, and were vaccinated against PRRS virus, circovirus, leptospira spp., Aujeszky virus and E. coli. Sows were reproduced by artificial insemination and natural mating. Sows were fed commercial diets, housed in crates and checked for estrus twice a day using a mature boar. They were inseminated three times at 12 hours interval of estrous detection. Cross-fostering was practiced in the farm.

Data and risk factors

Data of 6,063 sows were used. All sows had completed their life production cycle and had been removed from the farm. The response variables were the number of pigs born alive per sow per year (PBY) or per productive lifetime (LPB), number of pigs weaned per year (PWY) or per productive lifetime (LPW), kg of pigs weaned per sow per year (KPW), lifetime kg of pigs per sow (LKW) and productive lifetime (PL) of sows. Productive lifetime was defined as the number of days the sows stayed in the herd from the first to the last farrowing. PBY, PWY and KPY were obtained in the following way: if PL was less than 366 days then PBY and PEY and KPY were equal to LPB, LPW and LKW, otherwise LBP, LPW and LKW were divided by PLand multiplied by 365 days.

The risk factors studied were year of first farrowing (1998-2007), season of first farrowing (spring, summer, fall, winter), breed group of the sow (PIC, Yorkshire, F_1YL, Hampshire x Yorkshire3/4), and number of pigs born alive at first farrowing (<7, 7-8, 9-10, >10). The categories for number of pigs born alive at first farrowing were based on data quartiles.

Statistical analysis

The data were analyzed using descriptive statistics and general linear model procedures. The model included the fixed effect of year of first farrowing, season of first farrowing, breed group, and number of pigs born at first parity and year by season interaction. The statistical analyses were carried out using the SAS package [8].

3. Results and discussion

Means and standard deviations estimated for PBY, PWY, KPY, LPB, LPW, LKW and PLwere 21.4±3.71pigs, 18.2±4.04 pigs, 107.5±25.8 kg, 48.3±22.7 pigs, 41.4±3.71 kg, 243.7±122.9 kg and 805.6±338.8 days, respectively. Of the 6,063 sows 16.2% had 1 or 2 parities during their PL with a median of 5 farrowing. In addition, none of the sows produced 30 or more pigs weaned per year.

The number of pigs born alive per sow per year and LPW, in this study (21.4 and 48.3 pigs) is close to the 50th percentile (21.7 pigs) and the 75th percentile (50 pigs) found in 114 farms in Japan [2]. The mean PWY is lower than the means for USA (22.2 pigs) and Canada (23.4 pigs) reported by Koketsuet al [2]. In Spain, the poorest, middle and best farms for PWY had 15, 20 and 24.6 pigs, respectively [3]. In Venezuela, means of 31.7 pigs

and 223 kg for LPW and LKW, respectively, have been reported [4].

All factors studied had effect on all traits ($P < 0.05$), except, breed group for PBY, and season for PWY and LKW. The interaction of year by season was not significant only for PBY. The least squares means by main factors are shown in Table 1.

Table 1. Least squares means by factor for some productive traits of sows from a commercial farm in Michoacan, Mexico.

Factor	N	PBY	PWY	KPY	LPB	LPW	LKW	PL
Year of first farrowing								
1999	767	21.8±0.19^{d}	18.1±0.19^{d}	107.3±1.19^{ef}	53.1±0.99^{e}	44.7±0.89^{e}	265.7±5.35^{ef}	860±14.8^{ef}
2000	761	21.8±0.18^{d}	19.0±0.18^{ef}	107.7±1.13^{ef}	56.1±0.94^{f}	48.8±0.84^{f}	280.4±5.07^{g}	912±14.0^{fg}
2001	804	22.6±0.17^{e}	19.4±0.17^{f}	112.6±1.09^{g}	60.9±0.91^{g}	52.6±0.81^{g}	306.9±4.92^{h}	967±13.6^{h}
2002	614	22.7±0.18^{e}	18.6±0.18^{e}	108.9±1.14^{f}	58.1±0.95^{f}	47.9±0.85^{f}	279.7±5.12^{fg}	908±14.1^{fg}
2003	503	22.0±0.21^{d}	18.5±0.21^{de}	105.1±1.32^{de}	58.5±1.10^{fg}	49.6±0.98^{f}	282.3±5.94^{fg}	954±16.4^{gh}
2004	518	20.2±0.21^{c}	17.2±0.21^{c}	98.8±1.32^{c}	51.6±1.10^{e}	44.5±0.98^{e}	256.8±5.93^{e}	892±16.4^{f}
2005	564	18.7±0.19^{b}	16.2±0.19^{bc}	92.1±1.19^{b}	42.5±0.99^{d}	37.1±0.89^{d}	215.3±5.36^{d}	718±14.8^{d}
2006	518	19.2±0.22^{b}	16.8±0.22^{c}	101.2±1.41^{cd}	36.8±1.18^{c}	32.2±1.05^{c}	197.1±6.36^{c}	646±17.5^{c}
2007	674	19.0±0.19^{b}	15.9±0.19^{b}	102.7±1.23^{d}	26.7±1.02^{b}	22.5±0.92^{b}	146.7±5.54^{b}	482±15.3^{b}
2008	340	16.2±0.29^{a}	13.1±0.29^{a}	87.3±1.86^{a}	16.4±1.55^{a}	13.3±1.38^{a}	88.7±8.37^{a}	305±23.1^{a}
Season of first farrowing								
Spring	1636	20.6±0.12^{bc}	17.4±0.12^{b}	102.4±0.79^{ab}	46.7±0.65^{b}	39.8±0.59^{b}	234.2±3.54^{b}	770±9.58^{b}
Summer	1539	20.4±0.12^{b}	17.2±0.11^{ab}	102.4±0.76^{ab}	46.8±0.64^{b}	39.9±0.57^{b}	235.1±3.45^{b}	776±9.50^{b}
Fall	1342	19.9±0.15^{a}	17.0±0.15^{a}	100.8±0.93^{a}	43.7±0.78^{a}	37.5±0.69^{a}	220.6±4.20^{a}	729±11.6^{a}
Winter	1546	20.8±0.12^{c}	17.5±0.12^{b}	103.9±0.78^{a}	47.2±0.65^{b}	40.2±0.58^{b}	238.0±3.50^{b}	783±9.66^{b}
Genotype								
PIC	2590	20.5±0.11^{b}	16.9±0.11^{a}	100.7±0.69^{a}	47.4±0.58^{bc}	39.5±0.52^{b}	233.4±3.12^{b}	787±8.59^{b}
Yorkshire(Y)	1989	20.0±0.11^{a}	17.1±0.11^{a}	101.2±0.72^{a}	45.8±0.60^{b}	39.4±0.53^{b}	231.7±3.22^{b}	763±8.89^{b}
F1 YL	603	20.5±0.21^{b}	17.3±0.21^{ab}	102.2±1.37^{ab}	41.7±1.14^{a}	35.8±1.02^{a}	210.4±6.16^{a}	670±17.0^{a}
¾YL	881	20.7±0.15^{b}	17.8±0.15^{b}	105.3±0.98^{b}	49.3±0.82^{c}	42.7±0.73^{c}	252.3±4.43^{c}	817±12.2^{c}
Number of pigs born alive at first farrowing								
<7	1532	17.5±0.12^{a}	16.7±0.12^{a}	98.7±0.76^{a}	39.4±0.63^{a}	37.2±0.57^{a}	219.4±3.43^{a}	741±0.45^{a}
7-8	1560	19.8±0.12^{b}	17.3±0.12^{b}	102.6±0.76^{b}	45.2±0.63^{b}	39.8±0.49^{b}	235.0±3.41^{b}	773±9.39^{b}
9-10	2174	21.4±0.10c	17.6±0.10^{b}	104.1±0.66^{b}	48.9±0.55^{c}	40.6±0.49^{b}	239.4±2.98^{b}	784±8.21^{b}
>10	797	23.0±0.16^{d}	17.6±0.15^{b}	104.0±1.01^{b}	50.8±0.84^{d}	39.7±0.75^{b}	234.0±4.56^{b}	760±12.57^{a} ^{b}

^{a,b,c,d,e,f,g,h}Different literals between levels of a factor are significant ($P < 0.05$). PBY= Number of pigs born alive per sow per year; PWY= number of pigs weaned per sow per year; KPY= kilograms of pigs weaned per sow per year; LPB= lifetime pigs born alive per sow; LPW= lifetime pigs weaned per sow; LKW= lifetime kg of pigs weaned per sow, PL = Productive lifetime

Differences between farms or regions may be due to genetics, management differences and population structure, as well as litter size per farrowing and productive lifetime of the sows in the herd. In USA, Canada and Japan, means of 2.31, 2.37 and 2.28 litters per mated female per year were reported [2]. In this study, the number of litters per sow farrowed per year was 2.54.Productive lifetime mean differences between farms have been in southern Mexico [9].

The latest years (2006-2008) and the fall farrowing season had the lowest values for all variables studied. However, year of first farrowing by season of first farrowing interaction was significant for most of the traits studied, which indicates that season of first farrowing performs in a different way in different years. In some years there were season differences and in others did not. In Table 1,it can be appreciated that sows that had their first farrowing during 2006 to 2008 had the poorest performance. This is partially explained by the fact that those years only account per early culled sows and young sows. This is a limitation of retrospective studies like this compared to prospective cohort studies. Effects of period of years and month of first farrowing on pigs born alive per productive lifetime or PWY have been reported in Venezuela [4], whereas in Thailand significant effect of year-season effect on LPB and LPW were reported [10]. On the other hand, significant effect of season of first farrowing on PL was reported [11].

The best performance per year or PL per sow corresponded to the 3/4YL breed group, except for PBY where no differences were found. In addition, the 3/4YL sows stayed longer in the

herd. Breed group differences in this study must be look at with reserves, because cross-fostering was practiced. However, breed group differences for LPW and LKW were reported for Landrace and Large White sows and their crosses in Venezuela [4]. Similarly, Koonawootrittriron et al [10] reported bred group effect on LPB and LPW. In Switzerland [11,12, 13] reported average PL of Landrace sows (617 days), Landrace x Yorkshire (579 days) and Large White sows (602 days), respectively. Although farms effects confound breed comparisons, some pig lines are known for robustness, while others are much more vulnerable to environmental challenges. In addition, some breeds are more prolific than others are.

The sows with the smallest litter size at first parity (≤ 6 piglets) had the lowest mean values (Table 1). The effect of pigs born alive at first farrowing on the productive traits, here studied, agrees with other reports in the literature [6, 9,11, 12, 13]. They found that sows with small litters at first farrowing stayed less time in the herd and produced less pigs weaned during their PL (Table 1).

Under the conditions of this study, year, season, breed group and litters size at first farrowing had effect on productivity of sows; this differences were likely due to management decisions, breed prolificacy differences and litter size at first farrowing of sows. Some other factors not studied here, such as age at first mating of the sow, sanitary status of the herd and age structure of the herd may influence mean sow productivity and PL.

4. Conclusions

The environmental and breed group factors, here studied, had significant effect on most traits. Sows with small litters at first farrowing stayed less time in the farm. Productivity in the farm could be improved because none of the sows produced more than 30 pigs per year per sow.

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