Animal Reproduction Science xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Animal Reproduction Science

journal homepage: www.elsevier.com/locate/anireprosci

Modelling piglet growth and mortality on commercial hog farms using variables describing individual animals, litters, sows and management factors

Lucie Galiot, Isabelle Lachance, Jean-Paul Laforest, Frédéric Guay*

Département des Sciences Animales, Université Laval, Ville de Québec, Qc G1 V 0A6, Canada

A R T I C L E I N F O

Keywords:
Piglets
Pre-weaning mortality
Pre-weaning growth

A B S T R A C T

Increases in sow prolificacy have reduced piglet vitality, growth capacity and weight at weaning and even pig weight at slaughter. The aim of this study was to develop a model that predicts likelihood of mortality and weight at weaning. A database containing 3214 records of birth weight, weight gain at 24 h, rectal temperature at 24 h, litter size, age at weaning, fostering status, manual assistance of birth and oxytocin use as well as the corresponding 227 records of sow parity and feed intake was analysed using logit functions for mortality and linear functions for weaning weight. The best model of mortality predicted increased likelihood as birth weight, rectal temperature and 0–24 h weight gain decreased and sow parity and time between births increased ($P < 0.01$, $\chi^2 = 2910$). The best model of weaning weight predicted increases with increasing birth weight, 0–24 h body weight gain, age at weaning and sow parity and decreases with increasing litter size at 24 h ($P < 0.01$; AICC = 4324; RMSE = 0.82). This study confirmed that birth weight and weight gain during the first 24 h are the principal factors influencing piglet growth and pre-weaning mortality.

1. Introduction

The development of hyperprolific sows has increased the productivity of commercial swineherds. Litter size now averages more than 13 piglets, compared to 10 in the year 2000 in North America (CCSI, 2015; Porth, 2016). However, studies have shown that increases in litter size are associated with reduced growth and viability of suckling piglets (Berard et al., 2010; Baxter et al., 2008, 2009). Factors influencing piglet survival have been the subject of numerous studies and have been reviewed at least twice (Kirkden et al., 2013a,b; Muns et al., 2016). Low birth weight and sow multiparity are both well known to decrease pre-weaning survival of piglets (Fix et al., 2010b; Hales et al., 2013; Baxter et al., 2008, 2009). Low body weight gain and rectal temperature during the first 24 h are predictors of decreased likelihood of survival, as is being born towards the end of the farrow (Baxter et al., 2008, 2009). The impact of assisted farrowing remains unclear. Injecting oxytocin before or during farrowing might increase the incidence of stillbirth and total farrowing time, but its impact on the viability of suckling piglets is uncertain, as is the impact of manual intervention (Kirkden et al., 2013a,b). At least one study suggests that manual intervention has no significant impact on preweaning mortality (Panzardi et al., 2013). Transferring piglets from the mother to another sow (a common pig-raising practice called cross-fostering) might reduce pre-weaning mortality (Cecchinato et al., 2007) or increase it (Fix et al., 2010b).

Pre-weaning growth and piglet weight at weaning also depend on many factors including birth weight, litter size, sow parity,

* Corresponding author.
E-mail address: frederic.guay@fsaa.ulaval.ca (F. Guay).

https://doi.org/10.1016/j.anireprosci.2017.11.009
Received 12 July 2017; Received in revised form 29 October 2017; Accepted 9 November 2017
0378-4320/

cross-fostering and gain during the first 0–24 h. Piglets heavier at birth and those with greater 0–24 h gains have greater cumulative gain and weight at weaning (Quiniou et al., 2002; Fix et al., 2010a; Johansen et al., 2004; Decaluwe et al., 2014). Weaning weight is correlated negatively with litter size (Milligan et al., 2001, 2002) and is lower among piglets born of primiparous sows (Ferrari et al., 2014). Cross-fostered piglets appear to gain weight more slowly than non-fostered piglets (Hales et al., 2013).

Studies of piglet survival and growth on commercial farms are needed in order to unravel the factors that explain this variability. Parameters such as animal instrinsic characteristics and litter and livestock management practices have been considered separately in previous studies, and little useful quantitative information has emerged so far. The aim of the present study is to examine the relationships between these variables and to determine their impact.

2. Material and methods

The experimental protocol received approval from the Université Laval animal use and care committee and was carried out in accordance with the recommendations of the Canadian Council on Animal Care (CCAC, 2009). The study was conducted at two commercial farms: Centre d'excellence en production porcine (Saint-Anselme, Qc, Canada), where 125 Large White x Landrace sows (Genetiporc, St-Bernard, Qc, Canada) produce nearly 3500 weaned piglets per year (29 per sow), and Ferme Aldo Inc. (St-Lambert de Lauzon, Qc, Canada), where 1500 Large White x Landrace sows (Genetiporc, St-Bernard, Qc, Canada) produce 39,000 weaned piglets per year (about 26 per sow). Data were collected from September 2014 to July 2015.

2.1. Animal management

The two farms used the same genetic source, same sow general management practices and the same type of breeding-gestation (conventional stalls) and farrowing housing (conventional crates). The main difference was the presence of one IR lamp per farrowing crate instead of two (at Ferme Aldo).

Sows (n = 227, average parity 4.9 ± 3.0) were transferred to conventional farrowing crates (1.5 × 2.1 m) 5–7 days before the planned farrowing. Crates were equipped with two IR lamps (one behind the sow was turned off 24 h after farrowing, one or two others on the piglet side were kept on for the whole lactation period), a feeder, a nipple drinker and an automatic feed distributor system (Gestal Solo, Jyga Technologies, Lévis, Qc, Canada). All farrowing was induced by injecting Dinoprost Tromethamine (Lutalyse, Zeotis Canada, Kirkland, Qc, Canada) 24 h before the expected farrowing (114 days of gestation). Oxytocin was administered when more than 30 min elapsed after a birth. When more than 40 min elapsed, the next birth was assisted manually. At the age of 3 days, the piglets had their tails docked, received an injection of iron and male piglets were castrated.

2.2. Data collection

During farrowing, each fully formed live piglet was weighed and identified with an ear tag within 5 min of birth. Birth order and time of birth were also noted. The moment when the first piglet emerged was designated as t_0. Stillbirths and mummified piglets were recorded. Sows were weighed and the P2 backfat thickness was measured before farrowing and at weaning using an Anyscanner BF® backfat scanner (SEC Repro inc. Ange-Gardien-de-Rouville, Qc, Canada). All live piglets were weighed 24 h after birth and the rectal temperature was measured using a digital thermometer. Cross-fostering was established within 24 h of birth such that each sow nursed 13 ± 1 piglets.In cross-fostering protocol, piglets exceeding the number of sow functional teats were transferred to another sow with a number of piglets less than its number of functional teats but the transfers were limited as much as possible. The fostered piglets were selected randomly from within litters. The cross-fostered animals were registered as such in the database.

All mortality during the suckling phase was recorded with body weight, the date and the apparent cause. Piglets were weaned at the age of 17.5 ± 0.5 days. Each was weighed the day before. The Gestal system recorded individual daily feed intake by the sow and transferred it directly and automatically to the database.

2.3. Database creation

The database contains three different types of data: weight, time and temperature readings, animal status codes and calculated variables. Codes were used for status at birth ('live', 'stillborn', 'mummified', 'yes' or 'no' for oxytocin use, manual assistance and cross-fostering), status at weaning ('live' or 'dead'), cause of removal from the study ('crushed', 'starved', 'withdrawn and euthanasied by producer' [these piglets were weak or injured] and 'other'), birth weight classes 'low' (< 1.1 kg), 'medium' (1.1–1.6 kg), 'high' (> 1.6 kg), rectal temperature classes < 36 °C, 36–37.5 °C, 37.5–38.6 °C and > 38.6 °C and maternal parity classes 1, 2, 3, 4, 5, 6–7, 8–9 and ≥10. The classes of birth weight, rectal temperature and maternal parity were established in order to obtain the most equivalent distribution between classes.

Calculated variables included individual body weight gain for 0–24 h and for the birth to weaning interval, and the average gain by the litter over the same time intervals. Standard variations (coefficient of within-litter variation) of weights at birth, 24 h and weaning were also calculated. Birth delay was calculated relatively to time at birth of previous piglet.

2.4. Statistical analysis

The database was created using Excel™ (Microsoft Corporation, Santa Rosa, CA, USA). Software Minitab 17 (Minitab, Version 16,