Introduction

Feed intake and growth curves represent the pattern of feed intake and growth in relation to live body weight or time. When feed intake and growth curves are established, animal performance (days to market, feed usage, feed efficiency) and financial performance (feed cost per pig; gross margin per pig) can be evaluated. At the same time, opportunities to improve animal performance can be identified. An important advantage of establishing feed intake and growth curves (over maintaining records on average days to market and average feed usage per pig) is that animal performance can be evaluated at the various stages of production. For example, for developing phase feeding or split-sex feeding programs it is important to estimate the amounts of feeds that are consumed by the pigs within each individual phase or by the different sexes. Feed intake and growth curve can also be used to determine the marginal production costs (cost to produce one extra kg of live body weight or carcass weight). This is important information to determine the optimum shipping weight of pigs.

The objective of the current studies was to determine how many observations are required to establish feed intake and growth curves for different groups of growing-finishing pigs. At the same time, these feed intake and growth curves were used to evaluate the levels of performance in the new Prairie Swine Centre Inc. (PSCI) growing-finishing facilities.

Experimental Procedure

A total of 238 pigs were housed in either groups of twelve, five or one pig per pen, in three different room types in use in the new growing-finishing facilities at PSCI. The amount of floor space that was provided was 0.70, 0.79 and 1.67 m² per pig in the three group sizes, respectively. Barrows and gilts were kept separate. The pigs were kept in a thermo-neutral environment (environmental temperature >18°C); the experiment was conducted during the summer of 1992. From approximately 24 to 104 kg live body weight, the pigs were fed a pelleted barley, wheat, soybean meal - based diet with 2% added fat (calculated DE was 3250 kcal/kg; calculated total lysine was 8.5 g/kg). Pigs were fed ad libitum from single space feeders; water was freely available from nipple drinkers. Live body weight and feed disappearance were monitored weekly. It was estimated that feed wastage was less than 3% of feed disappearance.

Various mathematical functions were used to relate feed intake to live body weight (feed intake curve) and live body weight to time in the barn (growth curve). These functions can be characterized by the type of function (asymptotic or exponential) and the number of variables that are included (parameters). The smaller the number of parameters the fewer observations are required to develop the curves.
Results and discussion

The mean feed intake (FI), live body weight gain (LBWG) and feed efficiency (feed:gain, FCR) for gilts and barrows in the various group sizes are summarized in Table 1. There was a clear effect of sex on feed intake; barrows consumed approximately 13% more feed than the gilts in all group sizes. In the barrows, live weight gain was similar when housed in groups of 1 and 5 and tended to be lower at the largest group size. Gilts that were housed individually tended to gain faster than those housed in groups of 5 and 12 pigs per pen. Feed efficiency followed the same pattern as growth rate.

Table 1. Effect of group size and sex on performance of growing finishing pigs.

<table>
<thead>
<tr>
<th>Group size</th>
<th>12 pigs/pen</th>
<th>5 pigs/pen</th>
<th>1 pig/pen</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sex</td>
<td>Bar</td>
<td>Gilt</td>
<td>Bar</td>
</tr>
<tr>
<td>Init.LBW (kg)</td>
<td>Bar</td>
<td>23.9</td>
<td>24.4</td>
<td>23.3</td>
</tr>
<tr>
<td>Final LBW (kg)</td>
<td>Bar</td>
<td>105.1</td>
<td>104.1</td>
<td>103.8</td>
</tr>
<tr>
<td>LBWG (g/d)</td>
<td>Bar</td>
<td>840</td>
<td>777</td>
<td>891</td>
</tr>
<tr>
<td>FI (g/d)</td>
<td>Bar</td>
<td>2415</td>
<td>2160</td>
<td>2462</td>
</tr>
<tr>
<td>FCR (g/g)</td>
<td>Bar</td>
<td>2.874</td>
<td>2.782</td>
<td>2.777</td>
</tr>
</tbody>
</table>

*pooled standard error of the mean
When the various mathematical functions were evaluated to relate feed intake to live body weight it appeared that exponential functions (as used by ARC, 1981) were just as accurate as asymptotic functions (as used by NRC, 1988). The actual parameters within the mathematical functions differed for the various group sizes and the two sexes.

The weekly feed intakes in individual pens of barrows housed in groups of 12 are summarized in Figure 1. The feed intake curve (solid line) is the curve that best describes the pattern of feed intake for all the barrows at that group size. The individual data points show that in some pens the weekly feed intake was substantially different from the actual feed intake curve. It is thus important to get multiple observations when establishing feed intake curves. This is to “balance” the high values against the low values. When the individual data points were based on a two week period (Figure 2) the data points are much closer to the actual feed intake curve. It appears that high levels of feed intake in one week are followed by low levels of feed intake in the next week, or vice versa. This means that it is more meaningful to measure feed intake over a two week period than over a one week period.

![Figure 1. Per pen feed intake in barrows (12 pigs/pen) over 1 week periods](image1)

![Figure 2. Per pen feed intake in barrows (12 pigs/pen) over 2 week periods](image2)
In order to establish feed intake curves, feed intake should be measured over two week periods in at least two pens (or feeders) at each of three live body weight ranges: low (25-35 kg), medium (55-65 kg) and high (85-95 kg). It is important to measure at three live body weight ranges as the mathematical functions, from which feed intake and growth curves are developed, contain two parameters each.

In Figure 3, the actual feed intake curves for the gilts and barrows that were housed in groups of 12 are presented. It appeared that the difference in feed intake between the two sexes increases as pigs grow heavier. This information is important for developing split-sex feeding programs. It suggests that the difference in nutrient levels between gilt and barrow feeds should be (much) larger during the finisher phase than during the grower phase.

In Figure 4, the growth curve is presented for barrows that were housed in groups of five. The individual data points relate to the weekly average per pen live body weights. The solid line represents the growth curve that best represents the pattern of growth in all the barrows at this group size. The mathematical function for the growth curve is the Gompertz function which is a sigmoidal function that requires two parameters (a mature body weight and a rate constant that represents how fast the mature weight is achieved). Figure 4 illustrates that the Gompertz function accurately describes the pattern of growth in these pigs. The Gompertz function also accurately described the pattern of growth for the different sexes at the other group sizes; the actual parameters in the mathematical function varied for the different groups of pigs. Similar to the feed intake curve, only a limited number of observations are required to establish a growth curve for individual production units. It will usually be sufficient to obtain information on days in the barn and live body weights from those animals of which feed intake is measured to develop a growth curve.
Implications

The general pattern of feed intake and growth in gilts and barrows that were housed in various group sizes was accurately represented by various mathematical functions that included only two parameters each. This means that the number of observations that are required to establish feed intake and growth curves for individual production units can be reduced.

When feed intake and growth curves are combined they can be used to evaluate animal and financial performance in commercial swine production units and to identify means to further improve (financial) performance.