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Farrowing hut design and sow genotype (Camborough-15 vs 25% Meishan) effects on outdoor sow and litter productivity¹

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ABSTRACT: Performance measures were evaluated for 125 outdoor sows and litters of two crossbred genotypes (Camborough-15 and 25% Meishan) and in two farrowing hut designs (American-style and English-style hut). Contemporary breeding groups of second-parity sows were evaluated in an intensive, outdoor research unit. Sow genotype and hut designs were arranged factorially. Seven complete blocks were evaluated over a 21-wk period. No interactions between environment and genotype were identified for sow and litter productivity. Litters farrowing in the English-style huts weaned 1.5 more ($P < .05$) piglets per sow (because

of a lower preweaning mortality, $P = .05$) than did litters in the American-style huts. The 25% Meishan weaned 1.7 more ($P < .01$) pigs per sow than Camborough-15, because of a greater number of piglets born alive. The effects of hut style and genotype were additive and 25% Meishan sows in English-style huts weaned an average (\pm SEM) of $11.1 \pm .83$ piglets per sow. The English-style arc hut design may improve outdoor pig production and increase competitiveness of the intensive, outdoor system. The 25% Meishan genotype has potential for increased pigs weaned per litter that must be considered in light of other features of this genotype such as body composition.

Key Words: Farrowing, Meishan, Pigs, Production

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Introduction

Economic circumstances and concerns about animal welfare in intensive systems have led to a rapid increase in outdoor production in the United Kingdom (Edwards et al., 1994). Technologies from intensive, indoor systems are being applied to outdoor systems. Sows are bred in well-organized paddocks and moved to farrowing paddocks with the same intensive schedule as in a confinement unit. As an increasing proportion of sows are moved out of confinement, the average sow productivity in Great Britain has remained greater than 21 pigs weaned per sow per year and piglet mortality of outdoor herds is nearly the same as that of indoor herds (Bowman and Ott, 1993).

Modern, intensive outdoor sows are farrowed in individual huts, and litters are weaned at the same age as

indoors. Hut design is thought to be a crucial asset in baby pig survival. The genotypes that perform best under outdoor circumstances differ from those developed for intensive indoor systems (van der Steen, 1994). Sows must exhibit good maternal behavior, docile temperament, hardiness, and durability. The latter two characteristics require greater fat reserves for cold resistance and strong legs and feet (Edwards, 1995). The objective of this study was to evaluate performance measures for two farrowing hut designs using two distinct sow genotypes.

Materials and Methods

Experimental Units

The outdoor unit was on a site of approximately 13.6 ha. Gilts and sows were hand-mated in a paddock with a radial design (a hub with paddocks radiating outward). After a group was hand-mated, the animals were moved to a heat-check paddock with a heat-check boar.

Farrowing occurred in one of two 1.6-ha farrowing paddocks that contained 16 huts (Port-A-Hut, Storm Lake, IA), either American-style or English-style. The English-arc hut contained 31% more floor area (1.54×2.78 m, or 4.28 m²) than the American-style hut (1.54×2.15 m, or 3.32 m²), which had four straight-sided

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walls. Neither English- nor American-style huts contained inside guard rails. Each hut had a fender that measured 1.2×2.12 m and had a height of .31 m. The study used 12 American-style huts and 4 English arc-style farrowing huts in a given paddock. The fender remained in place 7 to 14 d after farrowing when the piglets were large enough to jump over the fender (at this point the fender could not contain the piglets and was of little use). Huts were bedded with wheat straw.

After weaning, huts were turned over and the bedding was burned. Between farrowing groups, the huts were moved to a new location nearby.

Piglets were counted daily and weighed at birth and weaning (approximately 28 d of age). Piglets found dead with membranes covering their faces and/or very close to the rear of the sow were identified as "found dead." This category was primarily, but not exclusively, stillbirths. Considering the piglets known to be born alive but that died during the lactation period, the cause of piglet death was identified as either crushed or unknown. Piglets were considered crushed if the body was either bruised or flattened.

Genotype and Feed

The breeding herd originated with gilts of each genotype bred in contemporary groups and managed as contemporaries. Genotypes were housed on a common paddock at all times, from acclimation to breeding, gestation, and lactation. As breeding, bred, or lactating females moved from breeding to gestation to farrowing paddocks, the social groups (containing each genotype) remained together. When sows entered their second parity, the hut treatments were randomly assigned. Thus, this study evaluated the productivity of second-parity sows. All gilts and sows were hand-mated with PIC 405 boars. Sows were grouped by breeding date in potential farrowing groups of 16 to 25 sows each.

Two genotypes were examined. PIC USA, Inc. supplied both the Camborough-15 (C-15) and the Exp-94 line. The C-15 line is a white, commercial maternal line. The Exp-94 line was a similar experimental maternal line, except it contained 25% Meishan. Each sow line was maintained in social groups containing both genotypes. Sows were maintained on the same diet of sorghum-soybean meal (14% crude protein) in cube form. During lactation, sows were brought to full ad libitum intake over the 1st wk of lactation.

Experimental Design and Analyses

Data were analyzed as a randomized complete block with seven breeding/farrowing groups of sows and four treatments arranged in a 2×2 factorial. Because all sows were second-parity, parity was not included in the model. All sires were of an identical genetic line. Season effects were contained in the block effect because blocks farrowed each 3 wk over a 21-wk period (during spring and summer months). One degree of freedom was as-

sessed for genotype (C-15 vs 25% Meishan), for hut design (English vs American styles), and for the interaction of genotype \times hut design. Data were analyzed using the general linear model procedure of SAS (1990) using the type III sum of squares.

Results

Interactions between environment and genotype were not significant for any measures of sow and litter productivity. However, significant effects were observed between environments and between genotypes. Table 1 presents least squares means for sow and litter productivity for effects of hut design. Preweaning mortality was significantly ($P < .05$) improved for litters in the English-style huts, which resulted in greater numbers of pigs weaned per sow. Sows in American-style huts weaned 8.5 pigs, whereas sows in English-style huts weaned 10.0 pigs per litter ($P = .02$).

Data are presented in Table 2 for measures of sow and litter productivity for the effects of sow genotype. The 25% Meishan genotype tended ($P = .06$) to have more pigs born alive than the C-15 genotype. The 25% Meishan genotype sows weaned 10.1 pigs and C-15 sows weaned 8.4 pigs ($P = .008$). The percentage of piglet preweaning deaths did not differ ($P > .20$) between the genotypes. Experimental (25% Meishan) sows were lighter before and after farrowing than C-15 sows ($P = .001$), but weight losses during lactation were similar.

Number of pigs weaned per litter showed striking effects of treatments. Because main effects of both hut style and genotype were significant for pigs weaned per sow, the combined effects were additive (Figure 1). In American-style huts, 25% Meishan sows weaned an average of 1.45 more pigs per litter than C-15 sows. The C-15 sows in English-style huts weaned 1.2 more piglets than C-15 sows in American-style huts. The 25% Meishan sows in English-style huts weaned 2.9 more pigs than C-15 sows in American-style huts.

Discussion

Several investigations have been reported about design features of indoor farrowing accommodations. An extensive evaluation by Curtis et al. (1989) identified design features of the indoor farrowing crate that increased or decreased preweaning mortality. Such a detailed evaluation has not been made of the variety of design features of outdoor farrowing huts.

Several laboratories from around the world have investigated alternatives to the traditional indoor farrowing crate. The farrowing crate promotes the welfare of the piglets by reducing crushing (McGlone and Morrow-Tesch, 1990) compared with an ordinary farrowing pen. However, the indoor farrowing crate restricts the movement of sows, which may have negative animal welfare consequences. Newer indoor farrowing crate designs are being investigated that not only give sows the freedom to turn around and fully interact with their

Table 1. Productivity of sows (least squares means \pm SEM) in American- and English-style huts

Measure	American	English	P-value
Number of litters	96	29	—
Piglets born/litter	11.3 \pm .40	11.7 \pm .58	.51
Piglets born alive/litter	10.4 \pm .039	11.3 \pm .57	.16
Piglets found dead/litter ^a	.9 \pm .18	.4 \pm .25	.10
Birth wt, kg/piglet	2.0 \pm .05	2.0 \pm .08	.97
Piglets died, number/litter	1.9 \pm .25	1.3 \pm .36	.15
Piglets weaned/litter	8.5 \pm .39	10.0 \pm .57	.02
Mortality preweaning, %	19.7 \pm 2.65	11.2 \pm 3.87	.05
Litter weaning wt, kg/litter	58.5 \pm 2.45	64.2 \pm 3.56	.15
Piglet weaning wt, kg/piglet	6.9 \pm .20	6.6 \pm .29	.38
Sow wt prefarrowing, kg	200.6 \pm 3.94	212.6 \pm 5.68	.06
Sow wt at weaning, kg	178.3 \pm 3.60	188.0 \pm 5.23	.10
Sow wt loss, kg/lactation	22.2 \pm 2.5	24.5 \pm 3.59	.56
Lactation length, d	29.5 \pm .50	29.6 \pm .72	.90

^aThese were primarily stillborn pigs, but some may have breathed and died shortly after birth.

piglets but also attempt to keep preweaning mortality at a low level (McGlone and Morrow-Tesch, 1990; Arey and Sancha, 1996; Cronin et al., 1996). Far fewer comparisons of design features are reported for outdoor farrowing accommodations.

One of the most important reasons for interest in outdoor production has been the low capital cost of such systems, which varies in different countries from 40 to 70% of the cost for conventional intensive systems (Thornton, 1988; Mortensen et al., 1994; Le Denmat et al., 1995). A common assumption about outdoor production systems is that the number of pigs weaned per litter may not be as high as for indoor units that use farrowing crates. If the perceived “problem” with preweaning mortality among outdoor units were overcome, the outdoor system might become more competitive with indoor systems.

Variable information exists on outdoor herds; mortality values from national recording schemes range from 17.5 to 20.1% (Edwards et al., 1995). Piglet preweaning death has several possible causes, of which the primary

cause in outdoor systems is crushing. The American-style hut clearly allowed a higher rate of piglet crushing than the larger English-style hut. Variable skill levels among staff and stockpersons also are considerations in extensive animal husbandry systems (Edwards et al., 1994).

Our results showed that pigs farrowed in English-style huts had an increased survivability, resulting in more pigs weaned. These results also indicate more pigs weaned by 25% Meishan sows than by C-15 sows. Generally, pigs produced outdoors are better able to cope with the stresses of weaning and show better food intake and growth over the transition phase (Edwards, 1995). Genetic makeup, including the increased fat stores and larger litter sizes in the Meishan breed, also may contribute to differences seen between the 25% Meishan and the C-15 line. An additive, positive effect for number of pigs weaned may be obtained by using the English-style hut and the 25% Meishan genotype. We found no reports in the scientific literature of outdoor sows weaning more than 10 pigs per litter (Camb-

Table 2. Productivity of sows (least squares means \pm SEM) of C-15 and 25% Meishan genotypes

Measure	C-15	25% Meishan	P-value
Number of litters	81	44	—
Piglets born/litter	11.1 \pm .43	12.0 \pm .54	.17
Piglets born alive/litter	10.3 \pm .42	11.4 \pm .53	.06
Piglets found dead/litter	.8 \pm .19	.5 \pm .24	.25
Birth wt, kg/piglet	2.0 \pm .05	2.0 \pm .07	.43
Piglets died, number/litter	1.8 \pm .27	1.4 \pm .34	.22
Piglets weaned/litter	8.4 \pm .42	10.1 \pm .53	.008
Mortality preweaning, %	17.9 \pm 2.8	13.0 \pm 3.6	.24
Litter weaning wt, kg/litter	58.5 \pm 2.61	64.2 \pm 3.33	.12
Piglet weaning wt, kg/piglet	7.0 \pm .21	6.5 \pm .27	.15
Sow wt prefarrowing, kg	220.5 \pm 4.17	192.6 \pm 5.34	.001
Sow wt at weaning, kg	198.3 \pm 3.82	168.0 \pm 4.86	.001
Sow wt loss, kg/lactation	22.5 \pm 2.65	24.3 \pm 3.40	.65
Lactation length, d	30.4 \pm .53	28.7 \pm .68	.03

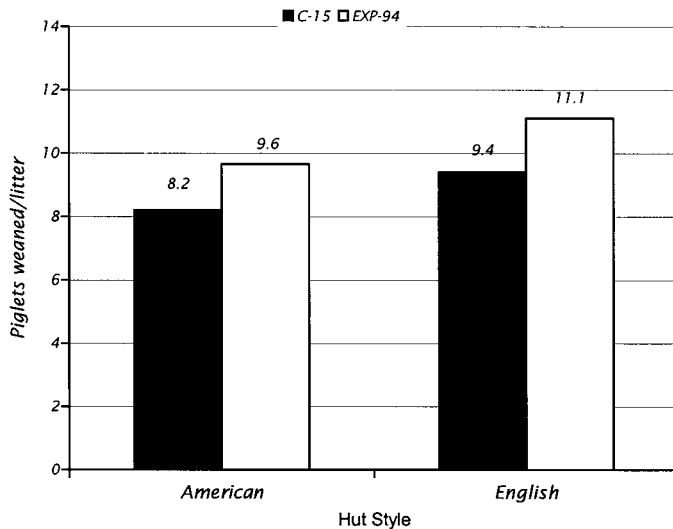


Figure 1. Number of piglets weaned per litter for each treatment. C-15 is the Camborough-15 genotype. Exp-94 is an experimental genotype with 25% Meishan. Figure values are least squares means. The main effects of genotype and hut style are significant ($P < .05$) and the combined effects are additive. Pooled SE = .68.

orough-15 sows in English-style huts) or more than 11 pigs per sow (25% Meishan sows in English arc-style huts).

The lack of a genotype \times environment interaction (hut type vs sow genotype) using huts and genotypes that individually had large effects on preweaning mortality indicated that a range of genotypes may be suited for relatively high levels of productivity in English arc-style farrowing huts. Still, until the comparisons are made, one cannot assume that certain genotypes of sows might not perform as well in the huts evaluated in this study.

The numbers of pigs weaned from the American-style farrowing hut approximates the U.S. average (8.5 pigs weaned per sow). However, with a preweaning mortality of nearly 20% (Table 1), the American-style farrowing hut may impose a welfare problem because of the increased number of crushed piglets. The English-style farrowing hut reduced preweaning mortality by over 40% compared with the American-style hut. In addition to the economic advantage of weaning more pigs, the welfare of the piglets would be improved by use of the English-style farrowing hut.

Implications

The experimental line containing 25% Meishan had improved numbers of piglets born and weaned per litter. However, the experimental line was probably too fat for commercial use at this time. However, the greater litter size may require the outdoor system to wean a large number of piglets. The farrowing hut was shown to have a significant effect on preweaning mortality, and this equipment should be carefully considered when outdoor systems are used. The outdoor system can be a competitive production system in terms of numbers of piglets weaned with the use of appropriate farrowing huts such as the English arc-style hut.

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