Australian Government
Department of Agriculture

AUSTRALIAN Pork™

Evaluation of Space Requirements for Group Housed Pregnant Pigs at Different Parities

Final Report
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1. Acknowledgements

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2. Executive Summary

Background and Justification

Intensive housing of pigs receives considerable media and public attention as a result of the perceived negative welfare benefits that arise. Space allowance is a key component of this as this aspect is easily discerned by a lay observer. Group housed systems by their nature appear to be more welfare friendly, but there is evidence to suggest that the agonistic interactions and the resultant injury that occurs in these systems, poses a considerable threat to good welfare. Whilst there are a large number of studies comparing housing systems for sows (and therefore by nature space allowance), requirements for space in group housed systems of sows remain relatively undefined. Studies which examine parity effects on space allowance were not found in the literature. Recommendations (legislated or advisory in Codes) for space requirements in adult pigs are few, and are probably based on current practice, which no doubt reflects the lack of scientific literature in this area. Within Australia, recommendations range from 1.4- 1.8 m^2 per pig (Cale 1979; Model Code of Practice for the Welfare of Pigs, 1998). In the EU directive the floor area available to group-housed gilts and sows must be at least 1.64 m^2 and 2.25 m^2 respectively, with an increase of 10% of space allowance being necessary for groups of animals of less than 6 and a similar reduction of 10% when groups of 40 or more animals are housed (EU Directive 2001/88/EC). This current project was designed to test the hypothesis that space requirements during pregnancy depend on sow age/parity and body size.

Experimental Methods

The study was designed to compare the effects of two space allowances during pregnancy (1.4m^2 and 2.8m^2) and two parity groups on (gilts versus parity 3 plus sows) on coping measures (immunological parameters, hypothalamic-pituitary axis effects and injury) and standard production parameters. The study has used 128 pigs (64 sows and 64 gilts) over 4 replicates. All work has been carried out at the Roseworthy piggery using Large White x Landrace animals.

Results Summary

The data obtained shows minimal effect of space allowance and parity on the measures of well-being evaluated. There is some evidence of improved reproduction in older parity sows provided with increased space allowance.

Conclusion and Implications

It appears that with the space allowances and parity of animals examined in this trial, few effects on these standard measures of well-being were recorded. However, the data suggests a possible reproductive benefit in providing a greater space allowance in older animals with cortisol levels in this cohort of animals tending to be higher than the cohort with the greater space allowance. While these effects were not significant, future research is warranted to replicate the experiment using a larger sample size. It would be of interest to examine a greater range of space allowances with a larger variance across the range of space allowances chosen.

3. Background to Research

There is an increasing public focus on animal welfare issues in all aspects of animal use and care, with production animals species under particular scrutiny. . In fact, welfare issues in the agricultural sector, particularly involving the intensive livestock industries, such as pigs and poultry, often receive greater public attention. In industrialised countries throughout the world pig farming has evolved from the traditional family farm to large, intensive systems with increased mechanisation. This change has brought about improvements in production parameters, the ability to control disease, and economies of scale but at the same time has raised concern about the possible impact on the welfare of animals housed in these systems. Media attention on such industries, and perhaps the general public's growing dissociation with the farming life, has probably contributed to this enhanced community awareness with regard to animal welfare. Demand for products from welfare friendly production systems is increasing and consumers are now in a strong position to influence the industry by using their "buying power". Public perceptions may also lead to reactive action by Government and Industry groups in response to an issue, for example by changing legislation, Codes of Practice or outlawing procedures (Barnett et al, 2001).

Intensive housing of pigs developed to make efficient use of available space without compromising productivity parameters and thus is one of the limiting factors for intensive breeding (Bogner, 1982).In addition, this is one easily recognisable aspect of husbandry systems that is perceived by the public to imply that welfare is poor. In the pig industry, this might include space provided in singly housed animals and whether it allows performance of normal behaviours, or that provided in group housed systems where agonistic interactions and the resulting injury and psychological distress are more likely to be a welfare concern. In relation to group housed animals and minimisation of aggression there are also likely to be complex interactions between space provided, group size, mixing strategies, resource availability and social structure of the individuals within the group.

It has been suggested that there are qualitative and quantitative space requirements (Scientific Veterinary Committee, 1997). Qualitative space is the space required for performance of normal activities such as feeding, exploring, carrying out social behaviour or for animals to remove themselves from visual contact with others. This implies a need for each animal to have an area of empty space around it to avoid continuous physical contact with others and to be able to defend this territory against invasion from conspecifics (Scientific Veterinary Committee, 1997). The concept of "crowding" has been introduced to describe movement or activity restriction caused by the physical presence of others (Fraser and Broom, 1990). Variables involved in this concept are number of animals, stocking density, social space (determined by reactions between animals), and the space itself (Myers cited in Scientific Veterinary Committee, 1997)). A large number of studies on the consequences of crowding have been performed in laboratory rodents. Noted adverse effects include: a decline in reproduction, increased infant mortality, increase in aggressiveness, disruption to normal social behaviour, an increase in adrenal activity and decreased gonadal activity in males (Bronson and Eleftheriou, 1963; Christian 1995). This work also showed that some animals withdrew from social interaction and only the strongest animals were able to reproduce (Myers cited in (Scientific Veterinary Committee, 1997)). Aggression is likely to be the key causative factor for the severe consequences of crowding on the above parameters (Scientific Veterinary Committee, 1997).

Whilst there are a large number of studies comparing housing systems for sows (and therefore by nature space allowance), requirements for space in group housed systems of sows remain relatively undefined. Studies which examine parity effects on space allowance were not found in the literature.

Recommendations (legislated or advisory in Codes) for space requirements in adult pigs are few, probably based on current practice, and no doubt reflect the lack of scientific literature in this area. Within Australia recommendations range from 1.4- 1.8 m^2 per pig (Cale 1979; Model Code of Practice for the Welfare of Pigs, 1998). In the EU directive the floor area available to group-housed gilts and sows must be at least 1.64 m^2 and 2.25 m^2 respectively, with an increase of 10% of space allowance being necessary for groups of animals of less than 6 and a similar reduction of 10% when groups of 40 or more animals are housed (EU Directive 2001/88/EC).

4. Objectives of the Research Project

This project was designed to test the hypothesis that space requirements during pregnancy depend on sow age/parity and body size. Specifically, the study was designed to compare the effects of two space allowances during pregnancy (1.4m^2 and 2.8m^2) and two parity groups on (gilts versus parity 3 plus sows) on coping measures (immunological parameters, hypothalamic-pituitary axis effects and injury) and standard production parameters. The data obtained shows minimal effect of space allowance and parity on the measures of well-being evaluated.

5. Research Methodology

The animals were housed according to a 2x2 factorial design incorporating the two space allocations and parity groupings. Each pen contained eight animals housed in a static group from just after mating to day 50 of gestation. All animals were mixed into their groups simultaneously. Measurements were taken at a number of timepoints through the study. These were: 1 hour prior to mixing into groups, 1 hour after mixing, 6 hours after mixing, 24 hours after mixing, 48 hours after mixing, 28 days following mixing and at gestation day 50. Outcome measures included:

1. Cortisol and haematology from blood sample
2. Visual injury score -An injury scoring method was used to serve as an indicator of the severity of aggressive encounters. This system was a modified version of the scheme developed by Karlen et al. (2007). The total number of injuries (scratches, abrasions and ulcers) were recorded for the body as a whole.
3. Lameness score- Locomotion was assessed by a single observer using a graded scale (4 grades) ranging from sound to severely lame. Observations were made on animals in locomotion following a short period to allow for stiffness following getting up.
4. Reproductive performance- litter size, total piglets born per sow, piglets born alive, and the number still born or mummified.

The above measurements were taken on six focal animals from each group. The study has used 128 pigs (64 sows and 64 gilts) over 4 replicates. All work was carried out at the Roseworthy piggery, with approval from the Animal Ethics Committee of the University of Adelaide, using Large White x Landrace animals. Work was conducted between March 2010 and February 2011.

Statistical Analysis

Values in the text are expressed as mean ± standard error of the mean (SEM). Data was analysed by analysis of variance with the group as the experimental unit. Probability values <0.05 were described as significant. Data was analysed using SPSS version 18 (SPSS, Chicago, IL, USA).

6. Results

6.1. Reproductive Performance

Table 1: Effect of sow parity (first versus third plus gestation) and space allowance (1.4 versus 2.8 m²) on reproductive performance

Sow parity	Space allowance (m² per pig)		Pooled across space allowance
	1.4	2.8	
Piglets born alive			
3rd gestation plus	9.48	11.09	10.27
1st gestation	10.07	9.13	9.61
Pooled across parity	9.78	10.11	
Pooled SEM			*1.11*
Total litter size			
3rd gestation plus	9.86[a]	12.50[b]	11.15
1st gestation	10.45[a]	9.54[a]	10.00
Pooled across parity	10.15	11.02	
Pooled SEM			*1.12*

[ab] indicate significant interaction; P < 0.05

6.2. Haematology

6.2.1. Variation with Parity and Space

Table 2: Effect of sow parity (first versus third plus gestation) and space allowance (1.4 versus 2.8 m²) on haematological parameters

Sow parity	Space allowance (**m²**per pig)		Pooled across space allowance
	1.4	2.8	
Total White Blood Cell Count			
3rd gestation plus	9.72	10.44	10.08[b]
1st gestation	16.89	14.78	15.83[a]
Pooled across parity	13.31	12.61	
Pooled SEM			*1.26*
Neutrophil: Lymphocyte			
3rd gestation plus	0.62	0.54	0.58[b]
1st gestation	0.30	0.37	0.34[a]
Pooled across parity	0.46	0.45	
Pooled SEM			*0.08*

[ab] within column indicate significant difference; P < 0.05

6.3. Cortisol

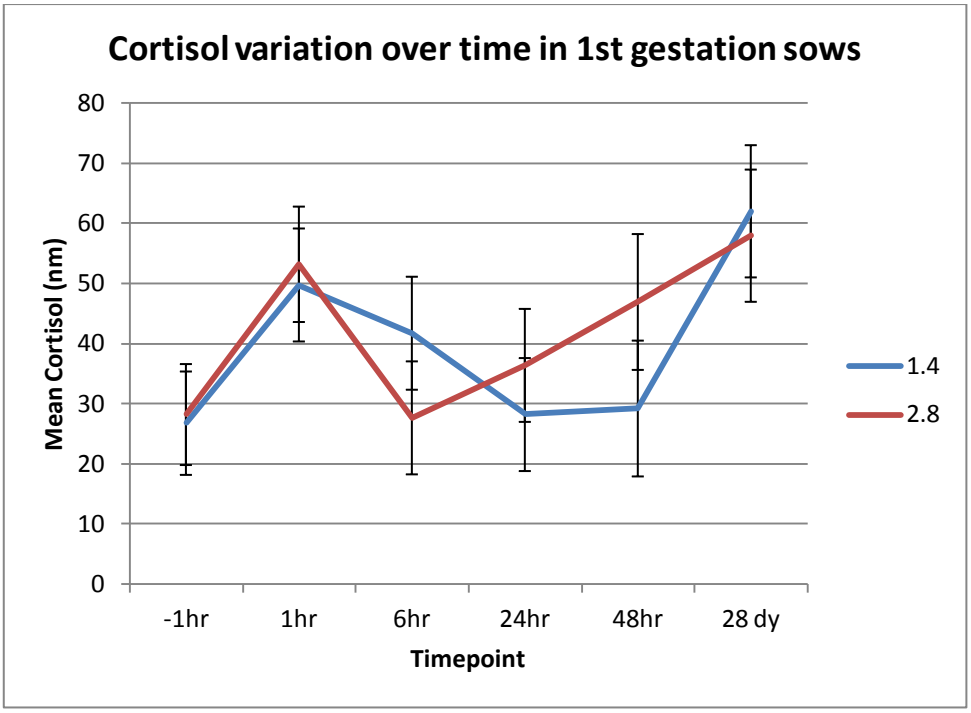
6.3.1. Variation with Parity and Space

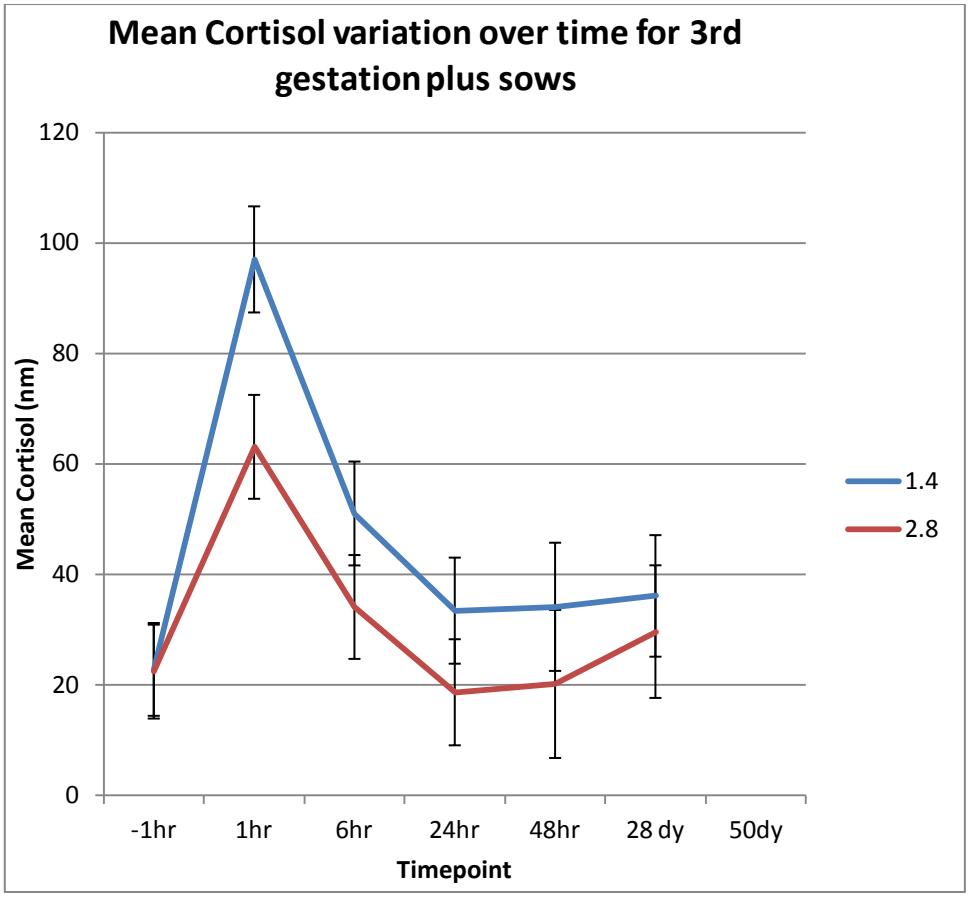
Table 3: Effect of sow parity (first versus third plus gestation) and space allowance (1.4 versus 2.8 m²) on cortisol

Sow parity	Space allowance (m²per pig)		Pooled across space allowance
	1.4	2.8	
Total cortisol concentration			
3rd gestation plus	45.77	31.36	38.56
1st gestation	40.74	41.73	41.2
Pooled across parity	43.06	36.55	
Pooled SEM			*4.25*

[ab] within column indicate significant difference; P < 0.05

6.3.2. Variation across Timepoint- Mean ± SEM





6.4. Injury and Lameness

6.4.1. Injury

Table 4: Effect of sow parity (first versus third plus gestation) and space allowance (1.4 versus 2.8 m²) on type of injury

Timepoint	Space allowance (m^2 per pig)		Pooled across space allowance
	1.4	2.8	
Scratches			
3rd gestation plus	8.48	8.61	8.55
1st gestation	9.88	6.44	8.16
Pooled across parity	9.18	7.52	
Pooled SEM			*1.64*
Abrasions			
3rd gestation plus	0.62	0.54	0.9[a]
1st gestation	0.30	0.37	0.26[b]
Pooled across parity	0.46	0.70	
Pooled SEM			*0.23*
Ulcers			
3rd gestation plus	0.26	0.13	0.19[a]
1st gestation	0	0	0[b]
Pooled across parity	0.13	0.06	
Pooled SEM			*0.06*

[ab] within column indicate significant difference; P < 0.05

Table 5: Effect of timepoint on type of injury

Timepoint	Gilt at 1.4	Gilt at 2.8	Sow at 1.4	Sow at 2.8
Scratches				
Pre-mixing	6.01	4.38	1.83	4.43
6 hour post-mix	7.95	5.50	1.83	7.73
24 hours post mix	12.39	8.29	1.82	9.94
48 hours post mix	13.16	7.58	1.83	12.33
Abrasions				
Pre-mixing	0	0	0.35	0.89
6 hour post-mix	0.4	0.04	0.38	1.55
24 hours post mix	0.7	0.04	0.42	1.38
48 hours post mix	0.7	0.25	0.77	1.46
Ulcers				
Pre-mixing	0	0	0.25	0.08
6 hour post-mix	0	0	0.29	0.12
24 hours post mix	0	0	0.29	0.16
48 hours post mix	0	0	0.20	0.15

[ab] within column indicate significant difference; $P < 0.05$

6.4.2. Lameness Score

Table 6: Effect of parity and space allowance on lameness score

Sow Parity	Space allowance (m^2per pig)		Pooled across space allowance
	1.4	2.8	
Lameness score			
3rd gestation plus	0.06	0.09	0.08
1st gestation	0.17	0.11	0.14
Pooled across parity	0.12	0.10	
Pooled SEM			*0.07*

7. Discussion of Results

Based on the results of this experiment there is little evidence to suggest that space has a significant effect on the parameters measured. Although there was no main effect ($P>0.05$) of space allowance or sow parity on total litter size and born alive piglets, there was a significant interaction between space allowance and sow parity with regards to total litter size ($P<0.05$) and born alive ($P=0.1$) (Table 1). The difference in results obtained between greater parity sows and gilts is interesting with improved reproduction being obtained at a greater space allowance in older animals with the converse being seen in gilts. This may be due to the relatively larger body size of sows in relation to gilts or be related to some aspect of temperament with gilts generally being more tolerant of other animals occupying their immediate space. An interaction of space and parity on cortisol approaches significance ($P= 0.06$), . Therefore with a greater number of animals significance may have been reached. There is also a statistically significant interaction of space and parity on the number of abrasions seen ($P= 0.01$). However, space allowance per se failed to show significant interaction with the welfare parameters measured. Timepoint of measurement showed significant effects with the majority of parameters measured (except cuts and ulcers). This is likely to be as a result of the effect of habituation of the animals to their new housing conditions following an initial stressful period (as evidenced by an initial cortisol increase), and some early agonistic encounters. The cortisol variation with time is of interest. In older parity sows there is an obvious peak around 1 hour after mixing followed by a fairly rapid decrease to pre-mixing levels by 24 hours. This implies that habituation to the stress of mixing is complete within a day in these animals. However, in gilts whilst a similar time course of this initial cortisol peak is observed, levels continue to rise again up until 28 days. It is postulated that this might be an effect of pregnancy (or related handling events such as scanning) on first parity sows which is not apparent in more experienced sows. However, given the variation in this between space allowances, and the small number of sampling points this would need further investigation to elucidate further.

8. Implications and Recommendations

In conclusion, it appears that with the space allowances and parity of animals used here few effects on these standard measures of well-being are attained. However, the data hint at a possible reproductive benefit to providing greater space allowance in older animals and a cortisol effect of space and parity may have been seen with a greater sample size. Future research might replicate the experiment with larger numbers of animals and it would be of interest to test a greater range of space allowances with a larger difference between the smallest and largest allowance chosen.