MOBILE AND STATIONARY SYSTEMS FOR ORGANIC PIGS – ANIMAL BEHAVIOUR IN OUTDOOR PENS

Christel Benfalk (1), Kristina Lindgren (1), Cecilia Lindahl (1), Margareta Rundgren (2)
(1) JTI – Swedish Institute of Agricultural and Environmental Engineering, P.O.Box 7033, SE-750 07, Uppsala, Sweden, +46 18 30 33 96, Christel.Benfalk@jti.slu.se, www.jti.slu.se, Kristina.Lindgren@jti.slu.se, Cecilia.Lindahl@jti.slu.se
(2) Swedish University of Agricultural Sciences, Dep. Animal Nutrition and Management, P.O. Box 7024, SE-750 07, Uppsala, Sweden, +46 18 67 20 57, Margareta.Rundgren@huv.slu.se, www.slu.se

Key Words: Fattening pigs, Defecating behaviour, Urinating behaviour, Excretion hotspots

Abstract

The production of organic pork in Sweden has increased. For several years, however, demand has been greater than production. An important factor contributing to the limited production is a lack of knowledge and experience of outdoor pig systems, since they are uncommon in Sweden. This study compared the behaviour of fattening pigs in two different organic production systems, with the main focus on excretory behaviour. In both the mobile and the stationary system there was an uneven distribution of manure and urine in the pens. In the mobile system, the hotspots were in the hut area and in part of the drinking area, while in the stationary system, the concrete pad as well as the wallowing area and the first section of the transportation area seemed to be the hotspots. Furthermore, the pigs avoided defecating around the feeding troughs and lying area in the mobile system. A more uniform distribution of nutrients can possibly be obtained by manipulating the excretory behaviour of the pigs, e.g. by regularly shifting the positions of the feeders and huts.

Introduction/Problem

Organic livestock farming, based on the production guidelines, has set itself the goal of establishing environmentally friendly production, sustaining animals in good health, realising high animal welfare standards, and producing products of high quality. In Sweden, the demand for organic pork has been greater than production for several years. An important factor attributing to the limited production is a lack of knowledge and practical experience, since outdoor pig systems are uncommon in Sweden (Alarik, 1999). In outdoor pen systems, the urine and faeces from the pigs are left directly on the ground, which with limited grass cover in the pen may lead to major nitrate losses during autumn and winter. Several studies have shown that pigs avoid defecating close to the lying area, feeding place, and the drinkers (Olsen *et al*., 2001; Stolba & Wood-Gush, 1989; Baxter, 1982). However, nutrient "hotspots" in the pen may be created, due to the excretory behaviour of outdoor pigs (Watson et al., 1998). Through daily allocation of new land, it is possible to influence the urination and defecation pattern (Andresen, 2000). Eriksen and Kristensen (2001) concluded that sows' excretory behaviour is affected by large amounts of feed, as it causes more excreta to be deposited in the feeding area. The results of Eriksen and Kristensen (2001) were based on investigations of manure mapping through soil samples, while Andresen (2000) used behavioural studies of urination and defecation. This study is a part of a larger project with the overall objective of identifying and recommending strategies that simultaneously provide a good animal environment, resource-efficient nutrient management, and a good working environment for pigs when producing pork in outdoor systems. The aim of this study was to compare the behaviour of fattening pigs, with the main focus on excretory behaviour, in two organic pig production systems.

Methodology

Two Swedish commercial farms with fattening pigs were studied, a mobile versus a stationary system, during 2002 and 2003 (May - November). In the mobile system the pigs were kept on arable land and had access to huts made of straw and tarpaulins. Each pen contained a hut, feeding troughs, water and wallowing facilities, and a grazing area. The pigs were transferred to a different plot of arable land every year. Each hut had a total area of 26 m^2 and the laying area for each pig was approx. 0.7 m^2. The group size of each pen was between 20 and 50 pigs.
In the stationary system, the pigs were kept in a barn with access to an outdoor area. The feeding trough, water facilities, and resting area with straw litter were located in the barn and each pen was 65 m^2. The group size of each pen was 40 pigs. The outdoor area started with a concrete pad of 39 m^2 per group, which opened onto a long, narrow grazing area where the wallowing facilities were located. In each

system, 5 groups of pigs were studied, for a total of 780 pigs. The pigs were studied at two different ages, approximately 15 and 20 weeks. Each observation day was 8 hours long and chosen according to the pigs' period of activity, with 4 hours in the morning and 4 hours in the afternoon.
The pens were divided into four sub-areas, corresponding to which activity the pigs performed in each area. The pens in the mobile system were divided into feeding area, hut area, drinking area, and grazing area. The wallowing area was placed either in the feeding or drinking area, depending on the pen design. The pens in the stationary system were divided into concrete pad area, wallowing area, transportation area, and grazing area.
Continuous recordings were made for defecating, urinating, drinking and wallowing. Each defecation and urination was also positioned on a map of the pen, where the different sub-areas were outlined. For eating, standing/walking, rooting, lying, grazing, and spending time in barn/hut, observations were made every 5 minutes. In the stationary system, eating and drinking behaviours were not registered because they were performed inside the barn. This also applies to defecating and urinating behaviour in the barn. After each observation day, manure mapping of the whole pen was done. The amount of manure was estimated on a scale 0-5, where 0 stands for no manure while 5 means that the ground was completely covered with manure.

The data were analysed by PROC MIXED according to SAS (SAS Institute Inc., 1996). The model statement included year, system, age, and sub-area within system as general fixed effects. Random variables were group within year and type of system.

Results and discussion

It was shown that general behavioural differences existed between the systems in the proportion of wallowing, rooting, lying (outdoors) and spending time in the barn/hut (figure 1). In the stationary system pigs spent more time inside the barn ($p<0.001$), which is partly due to the fact that feed and water were provided in the barn. In the mobile system the pigs had to go out of the hut to eat and drink.

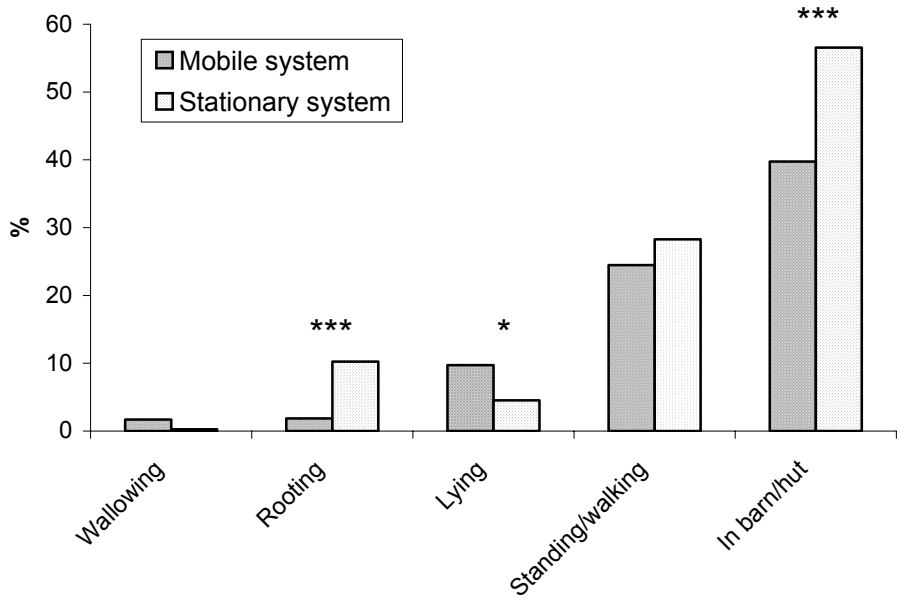

Figure 1. Proportions of general behaviour between systems (percent of total number of observations).

A significantly higher proportion of rooting ($p<0.001$) and a significantly lower proportion of lying ($p<0.05$) were seen in the stationary system. The proportion of rooting behaviour in the stationary system is in the same range as in a study by Andresen and Redbo (1999). The soil type was sandy loam. However, in the mobile system the level of rooting was very low compared to other studies (Stolba & Wood-Gush, 1989; Petersen, 1994; Andresen & Redbo, 1999). This was probably due to the fact that the soil type was clay, which became very hard during dry seasons. In the mobile system, pigs were observed to root around such places as the wallowing area and water facilities, where it was easier to root. The behaviour of drinking was studied only in the mobile system; the pigs drank mainly after feeding, before entering the grazing area, and when they returned from the grazing area. The pigs drank on average 6.8 times per observation day, and no differences were shown between year or age. There

were no disparities in general behaviour between the different ages except for rooting, which was performed more often when the pigs were 20 weeks compared with 15 weeks old ($p<0.001$).
In the mobile system, the pigs normally did not defecate in the hut. Pigs attempt to urinate and defecate far away from their resting area (Baxter, 1984; Stolba & Wood-Gush, 1989). The pigs defecate and urinate when they left the hut on their way to the feeding area (figure 2). Therefore, the highest concentration of faeces and urine was observed between the hut and the feeding trough. Both the behavioural observations and the manure maps show that the pigs did not discharge their faeces in the areas around the feeding trough or the water facilities. Pigs prefer to keep the feeding area free from faeces (Olsen et al., 2001). However, other studies have discussed the fact that a high level of N in soil close to feeders is probably caused by the large amounts of both feed and faeces deposited in this area (Eriksen & Kristensen (2001). The pigs did defecate and urinate on their way to and from the grazing area. When the pigs defecated or urinated in the grazing area, they had no noticeable preferences for where they discharged their faeces and urine.

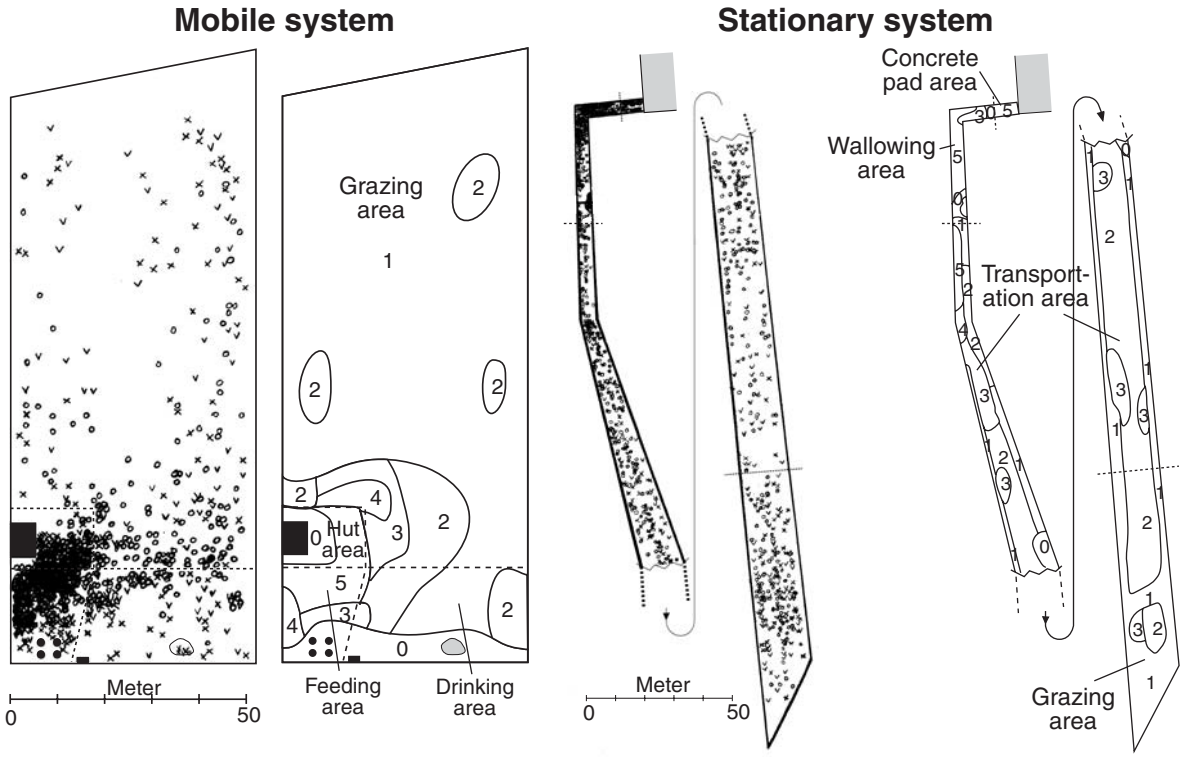

Figure 2. Manure map for one day of the behaviour study (left) and manure mapping (right) for one day, from the 0-5 scale, for one representative group. ○ = manure, x = urine from male pigs, v = urine from female pigs

In the stationary system, when the pigs went outdoors they defecated and urinated on their way to the grazing area (figure 2). The manure maps showed that the outdoor areas closest to the barn (the concrete pad, the wallowing area and the first section of the transportation area) had the heaviest manure loads, while in the rest of the outdoor area (secondary section of the transportation area and the grazing area), the manure was more evenly distributed.

In the systems investigated, both the pen and sub-areas within each pen differed in size. The number of pigs in each pen also differed both between systems and among pens within a system. By expressing the data as the number of defecations or urinations/10 m^2 and 10 pigs, the results obtained between sub-areas or pens within a system are comparable. It is to be noted that number of defecations/urinations is not proportional to the amount of faeces/urine, because the discharges are not equal in weight, for example due to differences in maintenance ration of fodder, especially between systems. The average concentration of faeces in each sub-area was significantly higher in the stationary system than in the mobile system ($p<0.05$) (table 1). Within the stationary system, the concentration of faeces and urine was significantly higher in the concrete and wallowing area than in the transportation and grazing area ($p<0.001$). The concentration of manure and urine on the concrete pad and in the wallowing area in the stationary system was higher compared to the hut area in the mobile system ($p<0.05$). These sub-areas, irrespective of system, were comparable due to their proximity to the resting areas (in the barn and in the hut). Also, the average size of these sub-areas was comparable. Olsen et al. (2001) stated that most outdoor urinations and defecations were placed in the wallow. We found that there were pigs defecating

and urinating in the wallow but not in such high levels as reported by Olsen et al. (2001), although the wallowing area was exposed to high levels of faeces and urine in the stationary system.

Table 1. The average concentration of faeces and urine in each sub-area (number of defecations or urinations/10 m^2 and 10 pigs).

System	Area	Conc. manure	Conc. urine
Mobile	Feeding	0.22	0.35
	Drinking	0.31	0.39
	Hut	0.44	0.54
	Grazing	0.07	0.04
Stationary	Concrete	0.75	0.83
	Wallowing	0.94	0.81
	Transportation	0.20	0.10
	Grazing	0.18	0.19

Conclusions

In both the mobile and the stationary system, it was concluded that there was an uneven distribution of manure and urine in the pens. In the mobile system, the hotspots were in the hut area and in part of the drinking area ,while in the stationary system, the concrete pad as well as the wallowing area and the first section of the transportation area were the hotspots. Also, the pigs avoided defecating around the feeding trough and in the hut in the mobile system. The concentration of defecations and urinations was higher in the hotspot areas in the stationary system than in the mobile system. A more uniform distribution of nutrients should be obtained by manipulating the excretory behaviour of the pigs. This can be done by regularly shifting the position of the feeders and the huts, but also by having a longer distance between these facilities. In the mobile system, it is easier to fulfil the mentioned requirements, as the whole system is mobile in its construction.

Acknowledgement

This study was financed by the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, the Swedish Institute of Agricultural and Environmental Engineering, and the Swedish Farmers´ Foundation for Agricultural Research.

References

Alarik, M. (1999). Dokumentation av ekologisk grisproduktion. Produktionssystem och produktionsresultat i sex ekologiska grisbesättningar under perioden 1997-1999. Hushållningssällskapet i Stockholms och Uppsala län, Uppsala.

Andresen, N. (2000). The Foraging Pig. Resource Utilisation, Interaction, Performance and Behaviour of Pigs in Cropping Systems. *Acta Universitatis Agriculturae Sueciae,* Agraria 227.

Andresen, N and Redbo, I. (1999). Foraging behaviour of growing pigs on grassland in relation to stocking rate and feed crude protein level. *Applied Animal Behaviour Science* 62, 183-197

Baxter, M.R. (1982). Environmental determinants of excretory and lying areasin domestic pigs. *Applied Animal Behaviour Science* 52, 183-195.

Baxter, S. (1984). Intensive pig production: *Environmental management and design*. Granada Publishing.

Eriksen, J. & Kristensen, K. (2001). Nutrient excretion by outdoor pigs: a case study of distribution, utilization and potential for environmental impact. *Soil Use and Management* 17, 21-29.

Olsen, A.W., Dybkjaer, L. & Simonsen, H.B. (2001). Behaviour of growing pigs kept in pens with outdoor runs II. Temperature regulatory behaviour , comfort behaviour and dunging preferences. *Livestock Production Science* 69, 265-278.

Petersen, V. (1994). The development of feeding and investigatory behaviour in free-ranging domestic pigs during their first 18 weeks of life. *Applied Animal Behaviour Science* 42, 87-98.

SAS. Inst. Inc. 1996. SAS/Stat Software, Changes and Enhancement through release 6.12.

Stolba, A. & Wood-Gush, D.G.M. (1989). The behaviour of pigs in a semi-natural environment. Animal Production. 48, 419-425.

Watson, C.A.; Anssems, E.; Kuhne, B.; Scholzel, Y.; Edwards, S.A. (1998). Assessing the nitrogen pollution risk from outdoor pig systems. In: Petchey, A.; d´Arcy, B.; Frost, A. (Eds.), Diffuse Pollution and Agriculture II SAC, Aberdeen, 230-235.