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Alternatives to nose-ringing in outdoor sows: 2. The provision of edible or inedible overground enrichment

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Abstract

*The nose-ringing of outdoor pigs (*Sus scrofa*), although commonly practiced as a means to inhibit rooting behaviour and therefore reduce pasture damage and soil erosion, has been questioned on ethical grounds and alternatives are being sought. In this experiment, the effect of overground environmental enrichment was assessed as a possible alternative. 12 multiparous sows were housed in groups of four and randomly allocated to one of three treatments in a 3 × 3 Latin square design. Treatments were: 1) no environmental enrichment, 2) edible overground enrichment in the form of grass silage, and 3) inedible overground enrichment in the form of branches and tyres. Sows that received silage as overground enrichment spent significantly less time rooting the paddock ($P < 0.01$) than did sows on the other two treatments. The absence of a significant difference between treatments in overall foraging time budgets suggests that the manipulation of edible substrates may substitute for rooting behaviour in outdoor sows.*

Keywords: *animal welfare, environmental enrichment, foraging, nose-ringing, pig, rooting behaviour*

Introduction

The nose-ringing of sows in outdoor pig herds is common commercial practice in the UK. This practice is considered necessary by many producers because of the strong motivation of pigs to root. In an outdoor situation, rooting behaviour leads to the removal of vegetative cover and the repeated overturning and compaction of the soil (Edwards *et al* 1998). Such damage contributes to nutrient leaching, soil erosion and sub-optimal field conditions.

Two types of nose-rings are used in the UK: bull rings, which are fixed through the nasal septum, and boss rings, which are clipped in multiples of three or more through the upper rim or edge of the snout. Both types of ring have been shown to be effective at reducing rooting behaviour and conserving vegetation cover (Horrell *et al* 2001). The practice of nose-ringing in outdoor herds has been questioned on ethical grounds by the Farm Animal Welfare Council (1996) in their review of the welfare of outdoor pigs, and it was suggested that alternatives should be sought. This is due to the apparent discomfort caused to the sow, both during the ringing process itself and whenever the snout subsequently comes into contact with a hard surface.

In the pig, the process of foraging encompasses the behaviours of grazing, browsing and, more commonly, rooting. Such behaviours are used by the pig to search for and ingest food. When considered in terms of total time budgets, pigs will spend up to 30% of their time engaged in rooting behaviour in semi-natural (Stolba & Woodgush 1989) or commercial outdoor conditions (Buckner *et al* 1998). The motivation to root appears to be very strong. Even in situations where no food reward can be obtained, for example when pigs are housed on concrete floors or are fed *ad libitum* (Horrell 1992), rooting still occurs.

In seeking a suitable alternative to the practice of nose-ringing, consideration must be given to the suppression or the redirection of foraging behaviour. Since rooting is a foraging activity, the provision of extra feed can reduce the level of hunger and the expression of foraging behaviours (Edwards *et al* 1993). This is not always practical, however, because of economic considerations and adverse effects on the reproductive performance of such animals. An alternative approach may be to provide environmental enrichment in the form of manipulable substrates, thereby redirecting foraging behaviour away from the paddock. The aim of this experiment was to determine whether such substrates reduce paddock-directed rooting, and also to ascertain whether edible substrates would be more effective than inedible ones. If paddock rooting behaviour is solely indicative of the pigs' desire to explore as a component of appetitive foraging behaviour, then both edible and inedible substrates should reduce rooting behaviour. If, however, paddock rooting occurs as a result of a high level of feeding motivation, then the edible substrate (grass silage) would be expected to reduce rooting behaviour over and above any reduction observed with the inedible substrate.

Table 1 Behavioural ethogram.

Behaviour	Description
Alert	Lying, sitting or standing; watchful but inactive
Asleep	Lying with eyes closed
Aggression	Threatening, knocking or fighting group-mate
Drinking	Drinking or manipulating water trough
Eliminating	Urinating or defecating
Grazing	Feeding on grass
Feeding	Feeding on concentrate feed from the ground
Moving	Moving around the paddock with no other behaviour
Nosing	Nosing group-mate
Out of view	In hut
Rooting	Rooting paddock using snout
Sniffing	Sniffing the ground
Chewing	Chewing with head up
Vocalising	Vocalising with no other behaviour
Wallowing	Lying in mud with eyes open
Branches	Manipulating branches
Tyres	Manipulating tyres
Silage	Manipulating silage

Materials and methods

Animals, housing and experimental design

Three groups of four multiparous sows (ranging between parity 2–8, mean parity = 5) were randomly allocated to one of three treatments in a 3 × 3 Latin square design with two week periods. Each group of sows spent two weeks in each paddock, and the three groups were rotated between paddocks such that the same treatment was always applied in each individual paddock and cumulative consequences for pasture damage could be seen. Sows on the first treatment served as a control group with no environmental enrichment being provided; those on the second treatment received edible overground enrichment in the form of *ad libitum* grass silage; and those on the third treatment received inedible enrichment in the form of branches and tyres.

Sows were housed in three adjacent paddocks (30 × 40 m) at a stocking rate equivalent to 33 sows per hectare. Each paddock contained shelter in the form of a sow hut and also a water trough. The paddocks were on an established ryegrass ley (1 year in grass) that had previously been grazed by cattle and sheep. Part of each paddock had housed outdoor sows for the eight weeks prior to the experiment; each paddock had then been partially relocated to incorporate 30% of new, previously ungrazed sward.

Sows were fed once daily at 0900 h (Sow Range Rolls, Farmway Ltd, UK; oil 5.5%, fibre 6.0%, protein 17.0%, ash 6.5%, moisture 14.0%). The level of feeding increased from 2 kg to 3 kg per sow per day as pregnancy progressed over the course of the experiment, with all groups receiving the same level of feed on any given day.

The grass silage (D value approximately 70) provided as one form of overground enrichment, was presented on an *ad libitum* basis in a trough placed at the front of the paddock. Silage was replenished daily, with refusals being weighed to enable levels of apparent silage intake to be calculated. The branches (n = 16 fresh branches of approximately 2 m length) and tyres (n = 8) were placed in a pile in the centre of the paddock at the start of each replicate (ie when the three groups of sows were rotated between the three paddocks). New branches and tyres were used for each replicate.

Measurements

Behavioural observations were made on three days of each week during four, 1 h sessions per day. The times of the observation sessions were as follows: 0930–1030, 1115–1215, 1300–1400 and 1500–1600 h. The posture and behaviour of each individual sow was recorded by instantaneous sampling at 5 min intervals using a hand-held event recorder (Workabout, Psion plc, UK) and the Observer software package (Noldus Information Technology, Wageningen, The Netherlands). The behaviours recorded are shown in Table 1. Individual sows were identified using a durable marker spray.

Data manipulation and statistical analysis

The Observer package was used to manipulate the behavioural data in order to obtain a mean frequency of occurrence for each of the behaviours in the ethogram. Certain behaviours occurred very rarely and were therefore removed from the analysis. These behaviours were: aggression, eliminating, nosing, vocalising and wallowing. For the remaining data, the percentage of observations for which each behaviour occurred in each 1 h session was calculated

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for each sow. Data were normalised using a Log_{10} transformation, and were then subject to analysis of variance (ANOVA) testing (Genstat 5 for Windows, 2nd Edition) to assess main effects of treatment (control, silage, branches/tyres) with replicate (n = 3), group (n = 3), pig (n = 12) and week (Week1, Week 2) included as blocking factors in the model. Effects of treatment were assessed at the replicate × group level with four degrees of freedom. Means were subject to *post hoc* pairwise comparison by calculation of least significant difference thresholds from the analytical output.

Results

Behavioural data were normalised using a log_{10} transformation. All means in statistical comparisons are presented as such in this section and therefore represent the transformed percentage of observations during which a pig was performing a given behaviour. Back-transformed values are also provided in square brackets.

Rooting activity

Pasture rooting behaviour was significantly affected by treatment. Sows that were offered silage spent significantly less time rooting the paddock than did sows on either of the other two treatments ($F_{2,4} = 58.26$; $P < 0.01$; see Table 2). There was also a tendency for paddock-directed rooting behaviour to increase between Weeks 1 and 2 of each replicate period regardless of treatment ($F_{1,35} = 4.02$; $P < 0.1$); however, there were no significant treatment × week interactions.

Pasture rooting behaviour was also significantly affected by the time at which behavioural observations took place ($F_{3,777} = 152.92$; $P < 0.001$). Highest levels were recorded immediately following feeding (1.516 [37.24]) and lowest levels were recorded between 1500–1600 h (0.363 [6.52]).

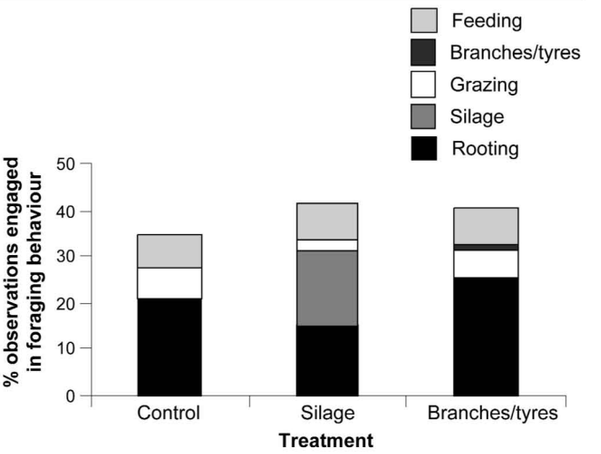
Manipulation of overground enrichment items

Sows that were offered branches and tyres as paddock enrichment spent less time manipulating the tyres during Week 2 of each time period (0.0120 [0.04]) than during Week 1 (0.0518 [0.16]). There were no significant changes between Weeks 1 and 2 in the time spent manipulating branches. This decrease in interaction with the substrate did not occur when the sows were offered silage.

Foraging behaviour

When total foraging behaviours were examined (feeding from the ground, manipulating the enrichment substrate, sniffing, grazing and rooting) there were no significant effects of treatment on the results obtained. Total foraging behaviour was, however, significantly affected by the time of day that the behavioural observations were made, with all treatments showing significantly greater levels of foraging activity during the first observation period (immediately following the provision of the daily feed ration). There were no significant treatment × time interactions. When sows were offered silage, the behaviour of manipulating the silage substituted for rooting the pasture to a considerable extent (see Figure 1).

Figure 1



The effect of treatment on the percentage of observations that outdoor sows spent engaged in different foraging behaviours.

There was also a non-significant trend for grazing activity to be lower in paddocks in which silage was provided as the overground enrichment (0.370 [2.34]) compared to paddocks containing either no enrichment (0.575 [6.28]) or branches and tyres (0.706 [5.95]) ($F_{2,4} = 2.57$; $P < 0.1$; see Table 2). None of the other behaviours measured (see Table 1) was significantly affected by treatment.

Silage intake

There were significant differences between the three replicates with respect to silage intake. Mean silage intake over the three replicates was 1.92 kg fresh weight/sow/day, with sows in replicate 1 consuming 1.17 kg/sow/day, those in replicate 2 consuming 2.35 kg/sow/day and those in replicate 3 consuming 2.19 kg/sow/day ($F_{2,38} = 4.91$; $P < 0.05$). This finding corresponded with significant differences between the replicates in terms of grazing activity. The proportion of observations spent grazing was highest for sows in replicate 1 (0.530 [9.35]), possibly as a result of greater initial levels of pasture cover, and lowest for sows in replicate 3 (0.104 [1.09]), with sows in replicate 2 being intermediate (0.232 [3.42]).

Discussion

The aim of this experiment was to develop a suitable alternative strategy to the practice of nose-ringing outdoor pigs. Overground forms of enrichment were provided in an attempt to divert the normal foraging behaviour of the sow away from the paddock and towards the enrichment substrate. The provision of an edible overground substrate (grass silage) did significantly decrease pasture-directed rooting activity. However, the initial 30% of new pasture was almost totally destroyed in all of the paddocks within the first two weeks of the experiment and, as such, paddock damage could not be meaningfully measured because of the lack of vegetation before the Latin square design had been completed. The provision of branches/tyres did not have the same effect as the silage with respect to reducing

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Table 2 The effect of treatment on the percentage of observations spent foraging by outdoor sows. Values were transformed on a log_{10} scale prior to analysis (back-transformed values are provided in brackets).

	Treatment					
	Control	**Silage**	**Branches/ tyres**	***F*-value (2,4 *df*)**	**SE**	***P*-value**
Feeding	0.907 (7.40)	0.925 (7.83)	0.900 (7.37)	1.93	0.0132	ns
Grazing	0.575 (6.28)	0.370 (2.34)	0.706 (5.95)	2.57	0.1667	<0.1
Rooting	1.339 (21.79)[†]	1.194 (15.48)[‡]	1.403 (25.31)[†]	58.26	0.0377	<0.001
Chewing	0.235 (1.04)	0.244 (1.14)	0.397 (2.30)	4.21	0.0738	ns
Sniffing	0.772 (5.66)	0.647 (4.61)	0.745 (5.22)	0.43	0.1412	ns
Silage	–	1.176 (16.28)	–	–	0.0900	–
Branches	–	–	0.176 (0.80)	–	0.1006	–
Tyres	–	–	0.096 (0.29)	–	0.0122	ns

[†‡] Figures in the same row bearing different superscripts are significantly different.

paddock-directed rooting behaviour. This suggests that the sows were attracted to the edible nature of the silage as opposed to the enrichment substrates *per se*.

In commercial production systems in which sows commonly receive their entire daily feed ration in the form of a single meal and consume it within minutes of presentation, the opportunity to perform foraging/consummatory behaviour in association with concentrate feeding is limited. In addition, commercial sow rations provide much less energy than the sow would choose to consume if fed *ad libitum*, and therefore satiety is rarely achieved (Lawrence & Terlouw 1993; Meunier-Salaun *et al* 2001). When combined, such factors lead to chronically high levels of feeding motivation and this has been shown to contribute to the development of oral stereotypies in indoor sows (Lawrence & Terlouw 1993; Meunier-Salaun *et al* 2001), and is likely to underlie paddock rooting behaviour in outdoor sows.

Incorporating an increased level of fibre in the diet can also modify oral behaviours and foraging activity in indoor sows (Robert *et al* 1993; Brouns *et al* 1994; Whittaker *et al* 1998, 1999). This effect would appear to be mediated by an increase in feeding duration and gut fill with such diets (Meunier-Salaun *et al* 2001). Grass silage offers animals the opportunity to engage in oral manipulatory behaviour, to prolong the time occupied by consummatory behaviour, and to achieve significant nutrient intake and gut fill (Edwards *et al* 1994).

The provision of grass silage not only reduced the level of paddock rooting behaviour, but also tended to decrease the frequency of grazing. This would seem to indicate that sows offered silage were more satiated than their counterparts in the control group and in the group offered branches/tyres. With the intakes and silage quality recorded in this experiment, it can be estimated that sows obtained on average 6 MJ of digestible energy per day from this source, which represents a 15–20% increase in energy intake compared to the treatments without silage. However, the bulk of the diet may be as important as its nutrient contribution in terms of inducing satiation. Braund *et al* (1998) reported a reduction in foraging behaviours in outdoor sows fed a high-fibre sugar-beet pulp diet. Rooting, nosing, digging and grazing behaviours all occurred less frequently in sows offered the high-fibre diet, even when food was provided only once per day in a rationed amount. This therefore suggests that diets that increase the sows' ability to achieve gut fill will be most effective in decreasing the occurrence of foraging-type behaviours and therefore in decreasing rooting.

In addition to analysing the effect of environmental enrichment on the occurrence of rooting behaviour, it is also of interest to ascertain how the overall foraging time budget was affected. Total foraging activity included the behaviours of feeding on concentrates, sniffing the ground, grazing, rooting the paddock and manipulating the enrichment substrates. It appears that although the timing of the observations significantly affected the frequency of occurrence of such behaviours (with highest levels of foraging activity occurring immediately after feeding), there was no overall effect of treatment. This implies that behaviour directed towards the edible substrate substituted for rooting activity, but did not affect the overall frequency or diurnal pattern of total foraging.

The success of any potential alternative to the nose-ringing of outdoor pigs would need to be measured by its ability to decrease the pasture damage that is seen when pigs do not have nose-rings. In a previous study (Bornett *et al* 2003) conducted on the same site, the most successful treatment was the provision of a 15 × 2 m strip of the paddock that was ploughed to create a sacrificial rooting area into which 100% of the pigs' daily feed ration was buried. This was designed to redirect rooting behaviour away from the paddock as a whole, and was found to decrease rooting activity outside the sacrificial area by 35%. As a result, 30% of the initial pasture cover remained at the end of the eight week experimental period, compared to 0% in control conditions. In the current experiment, sows that received silage as the form of enrichment showed only an 11% decrease in rooting activity. This suggests that the provision

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of silage did not greatly reduce paddock damage. In the experiments of Braund *et al* (1998), the provision of high-fibre diets, although successful in decreasing foraging behaviour, did not significantly decrease the level of paddock damage. Therefore it seems that merely increasing gut fill cannot totally suppress the sows' desire to root. In the current study, despite the presence of *ad libitum* forage, the animals continued to show rooting behaviour, which might reflect motivations to seek food variety or specific micronutrients, or might represent exploratory behaviour to collect information on food resource availability and location.

Based on the results of this study, it is concluded that the provision of overground edible forms of environmental enrichment could not provide a commercially suitable sole alternative to the practice of nose-ringing outdoor pigs; however, it might be useful as part of a more complex strategy for reducing and/or redirecting foraging motivation.

Conclusion and animal welfare implications

The provision of edible enrichment in the form of grass silage reduced the paddock rooting behaviour of dry sows, whereas inedible enrichment did not. However, the results of this study do not suggest the provision of grass silage to be an effective sole alternative to nose-ringing in terms of maintaining pasture cover. From a welfare point of view, further research needs to be conducted on other possible alternatives to the nose-ringing of outdoor sows.

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