Agri-Food and Biosciences Institute

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The effect of drinker design on the performance, behaviour and water usage of growing pigs

Report prepared for: UFU and PPDC Committees

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1. EXECUTIVE SUMMARY

Water intake is a key factor influencing feed intake, which is the main driver of growth in pigs. Factors which can reduce water intake include poor drinker design. In addition the economy of water usage is important for both financial and slurry volume control reasons. A total of 720 Landrace x Large White pigs, grouped in pens of 20, were offered water from six different drinker arrangements. The standard Drik-O-Mat bowl drinker was compared with the normal Verba nipple drinker, the Halfman Bite drinker and the Jalmarsen Bite Ball drinker, flow rates (ml/min) 250, 600, 700 and 1200 respectively. Two drinkers/nipples were offered per pen. The position of the Drik-O-Mat bowl and Verba nipple drinkers was also compared. Drinkers were either placed side by side or 2 metres apart. When pigs were offered water from the 6 drinker arrangements, no difference in growth performance was found. However, significantly more water was used with the Halfman Bite and Jalmarsen Bite Ball drinkers compared to the Drik-O-Mat Bowl and Verba Nipple drinkers. Behavioural observations showed that this was due to a greater use of these drinkers for 'recreational' purposes than other drinkers. Although pigs appeared to adapt more quickly post weaning to the Halfman Bite and Jalmarsen Bite Ball drinkers, overall the extra water used was assumed to be wasted and increased slurry volume. If this assumption is correct the use of the Halfman Bite and Jalmarsen Bite Ball drinkers, compared to the Verba nipple drinkers resulted in an extra 17 and 32 tanker loads (1500 gallons) of slurry produced per year respectively. When the Drik-O-Mat Bowl drinkers were placed apart, significantly less water was used compared to when they were side by side. This was accompanied by a significant reduction in swapping between drinkers. These effects did not occur to the same extent when Verba Nipple drinkers were placed apart, and this suggests that the benefits of placing drinkers apart are reduced when higher water flow rates are used. In conclusion, no difference in growth rate of weaned pigs from 4–10 weeks of age was observed with pigs offered water via either Drik-O-Mat bowl, Verba Nipple, Halfman Bite or Jalmarsen Bite Ball drinkers but significantly more water was used with the latter two drinkers. There is some evidence that water usage could be reduced by placing Drik-O-Mat bowl drinkers approximately 2 meters apart within pens.

2. INTRODUCTION

Maximum feed intake in pigs is heavily reliant on adequate water supply and quality (Barber *et al*., 1989). Inadequate water intake is associated with reduced feed intake, poor daily gain, poor feed conversion, scour problems and lower digestibility of feed (Carroll, 2003). Factors that can reduce water intake include contamination, high mineral content, temperature, low flow rate from drinker, too few drinkers or poor drinker/nipple position (Carroll, 2003). It is recommended that there should be one nipple/drinker for every 10 weaned pigs (Whittemore, 1993) and that it should be positioned approximately 35–40 cm above floor level for weaned pigs. However, there is a lack of information on the effect of nipple design on water intake, performance and behaviour. There are three designs of drinker commonly used – nipple drinkers, bite drinkers and bowl drinkers. Bite drinkers are reported to be less wasteful than nipple drinkers, especially for newly weaned pigs and bowl drinkers are reported to result in less water wastage due to the water being retained in the

bowl (Philips and Philips 1999). This retained water is very susceptible to spoilage, which could greatly decrease the intake of water. However, Brumm *et al*. (2000) reported no difference in growth performance when a swing nipple drinker, a fixed nipple drinker and a bowl drinker were compared. Nevertheless, there is a need to further investigate the effect of drinker design on water usage, performance and behaviour. Rath (2000) compared water delivery, and pig performance using nipple drinkers and bite ball drinkers and reported that the use of bite ball drinkers reduced water usage by 15% with no change in pig performance. A reduction in water usage may reduce the volume of slurry produced and is worth further investigation, especially in the light of the proposed action plan to facilitate compliance with the Nitrates Directive and Integrated Pollution Prevention and Control legislation.

3. MATERIALS AND METHODS

3.1 Experimental design and animals:

A total of 720 ¾ Landrace x ¼ Large white pigs were weaned at 4 weeks of age and balanced for weight, gender and sire into groups of 20 which were randomly allocated to one of six treatments over six replicates.

3.2 Treatments:

1) Standard Drik-O-Mat bowl drinker – 2 bowls side by side.
2) Standard Drik-O-Mat bowl drinker – 2 bowls placed 2 meters apart.
3) Vebra nipple drinker – 2 bowls side by side.
4) Vebra nipple drinker – 2 bowls placed 2 meters apart
5) Halfman Bite drinker (NI) – 2 drinkers in a forked arrangement, 30 cm apart.
6) Jalmarsen Bite ball Drinker - 2 drinkers in a forked arrangement, 30 cm apart

After weaning, pigs were housed in combined stage 1/stage 2 accommodation (0.38 m^2/pig) with plastic slatted floors. Temperature was 28ºC on the first day of treatment which was reduced by 0.5ºC/day to 18ºC where it remained for the rest of the treatment period. The pigs were exposed to natural lighting through windows and artificial lighting (6250 lux). All pigs were offered pelleted feed *ad libitum* from dry multi-space feeders (one per 10 pigs) (Etra Feeders, Northern Ireland) of traditional design with the feed hopper connected directly to the trough with an adjustable aperture to regulate feed flow. Commercial diets were offered between 4 and 8 weeks of age after which pelleted diets formulated at ARINI were offered to finish.

3.3 Production performance measurements

Pigs were individually weighed and feed intakes were established at 4, 7 and 10 weeks of age. Average daily gain (ADG g/day), average daily feed intake (ADFI g/day) and feed conversion ratios (FCR) were subsequently calculated. Water intake was also recorded during the growing period.

3.4 Behaviour measures

The behaviour of pigs around each of the drinkers was video recorded (24-hour time lapse) for one 24-hour period when pigs were 4, 7 and 10 weeks of age.

3.4.1 General usage of drinkers

Instantaneous scans were made of each of the drinkers (including each half of the Halfman Bite drinker and Jalmarsen Bite Ball drinkers) every hour to record a number of parameters. These included whether or not a pig was drinking from the drinker, the number of pigs apparently queuing to use the drinker (i.e. in close proximity to the drinker and orientated towards the drinker while another pig used the drinker), and also the number of pigs standing in close proximity to the drinker but not apparently queuing to use the drinker. A pig was defined as being in close proximity to the drinker when its head was within 0.5 m of the drinker.

3.4.2 Behaviour at drinkers

More detailed measures of behaviour at the drinkers were also made from each of the video-taped observations. This involved observing both drinkers in a pen simultaneously for a continuous 10-minute period at 0800, 1000, 1200 and 1400 hours. The duration of each drinking bout within these observations was recorded. In addition, the number of times a pig removed its head from the drinker or switched between drinkers during a drinking bout was also recorded.

The mode by which each drinking bout ended was also recorded as follows:

1) Pig left the drinker voluntarily (left voluntarily)
2) Pig left the drinker after non aggressive contact from another pig (moved – non-aggressively)
3) Pig left the drinker following aggressive contact from another pig (moved – aggressively)
4) Pig left the drinker following non-aggressive contact from another pig and was displaced at the drinker by that pig (displaced – non-aggressively)
5) Pig left the drinker following aggressive contact from another pig and was displaced at the drinker by that pig (displaced – aggressively)

The aggressive contact mentioned above included pushing, vigorous rubbing, headthrusting, biting or mounting, and non-aggressive contact included behaviours such as gentle nosing. The proportion of drinking bouts which ended by methods (1) to (5) listed above was calculated and used in statistical analysis.

3.5 Statistical Analysis

The data were analysed using Genstat, version 5 (Lawes Agricultural Trust, 1989). The influence of treatment factors on performance, behaviour and water usage was analysed on a pen basis by analysis of variance (blocked for replicate). The within-group coefficient of variation was calculated for body live weight and growth rate by dividing within-group standard deviation values by group mean values. Within the behaviour analysis comparisons between the six different treatments, between different positions of bowl drinkers (side-by-side or apart), and between different designs of bowl drinkers (Drik-O-Mat or Verba) were made. In the hourly scan observations, the effect of treatment on the presence or absence of a pig at the drinker was assessed by calculating the proportion of scans over 4-hour periods where a pig was observed at the drinker.

4. RESULTS

Pig performance

The design or position of drinker had no effect on the growth performance, feed intake or feed conversion efficiency of pigs (Table 1). Drinker design or position had no effect on growth rate variability within the pen (Table 2).

4.2 Water usage

Flow rates were measured as (ml/min) 250, 600, 700 and 1200 for the Drik-O-Mat bowl, Verba Nipple, Halfman Bite and Jalmarson Bite Ball (Jalmarson, Sweden) respectively. Drinker design and position had a significant effect on water usage (Table 3). Compared to the Drik-O-Mat bowl and Verba nipple drinkers, from 4–10 weeks of age, water usage tended to increase when the Halfman bite drinker was used and was significantly ($P<0.001$) greater when the Bite Ball drinker was used. Overall from 4–10 weeks of age, when the Drik-O-Mat bowl drinkers were placed apart water usage was significantly ($P<0.001$) lower than when they were placed side by side. This effect did not occur with the Verba nipple drinkers.

Water intake on a daily basis from the different treatments during the first week and at day 14 and 21 after weaning followed a similar trend to the overall trend observed in Table 3, with the exception of the water intake on the first day after weaning where no significant difference was found between any of the treatments (Table 4).

Pigs offered water via the Halfman bite and the Bite Ball appeared to adapt to the drinker design more quickly and hence drink more water on the second day after weaning than pigs offered water from the other treatments (Figure 1). After day 2 water intake patterns gradually increased in parallel for all treatments (Figure 1).

Table 1 Performance of pigs from 4 to 10 weeks of age offered water from different drinker designs in different positions

		Drik-O-Mat Side by side	Drik-O-Mat Apart	Verba Side by side	Verba Apart	Halfman Bite	Jalmarsen Bite Ball	Sem	Sig
Average daily gain (g/day)	4-7 wks	356	372	357	351	361	341	8.5	NS
	7-10 wks	626	658	643	633	646	636	11.8	NS
	4-10 wks	495	518	504	495	507	492	8.1	NS
Average daily feed intake (g/day)	4-7 wks	433	430	419	421	442	429	13.8	NS
	7-10 wks	1048	1061	1067	1045	1056	1046	18.1	NS
	4-10 wks	748	752	751	744	756	742	13.1	NS
Feed Conversion Ratio	4-7 wks	1.22	1.17	1.18	1.21	1.23	1.26	0.033	NS
	7-10 wks	1.69	1.63	1.67	1.66	1.65	1.65	0.025	NS
	4-10 wks	1.52	1.46	1.49	1.50	1.50	1.51	0.022	NS

NS Not Significant

Table 2 Coefficient of variation for live weight and average daily gain of pigs from 4 to 10 weeks of age offered water via different drinker designs in different positions

		Drik-O-Mat Side by side	Drik-O-Mat Apart	Verba Side by side	Verba Apart	Halfman Bite	Jalmarsen Bite Ball	Sem	Sig
Live weight	4 wks	0.142	0.142	0.146	0.141	0.149	0.148	0.0044	NS
	7 wks	0.136	0.165	0.185	0.145	0.155	0.162	0.0115	NS
	10 wks	0.142	0.138	0.159	0.130	0.146	0.134	0.0091	NS
Average daily gain	4-7 wks	0.260	0.303	0.304	0.242	0.260	0.271	0.0353	NS
	7-10 wks	0.190	0.191	0.161	0.147	0.160	0.151	0.0195	NS
	4-10 wks	0.194	0.168	0.190	0.158	0.183	0.158	0.0142	NS

NS Not Significant

Table 3 Water usage (litres/pig/day) of pigs from 4 to 10 weeks of age offered water from different drinker designs in different positions

	Drik-O-Mat Side by side	Drik-O-Mat Apart	Verba Side by side	Verba Apart	Halfman Bite	Jalmarsen Bite Ball	Sem	Sig
4-7 wks	1.70^{bc}	1.02^{a}	1.61^{ab}	1.66^{b}	2.29^{cd}	2.76^{d}	0.207	***
7-10 wks	3.41^{ab}	2.63^{a}	3.56^{b}	3.56^{b}	4.20^{bc}	4.79^{c}	0.305	**
4-10 wks	2.57^{b}	1.84^{a}	2.61^{ab}	2.65^{ab}	3.27^{bc}	3.79^{c}	0.248	***

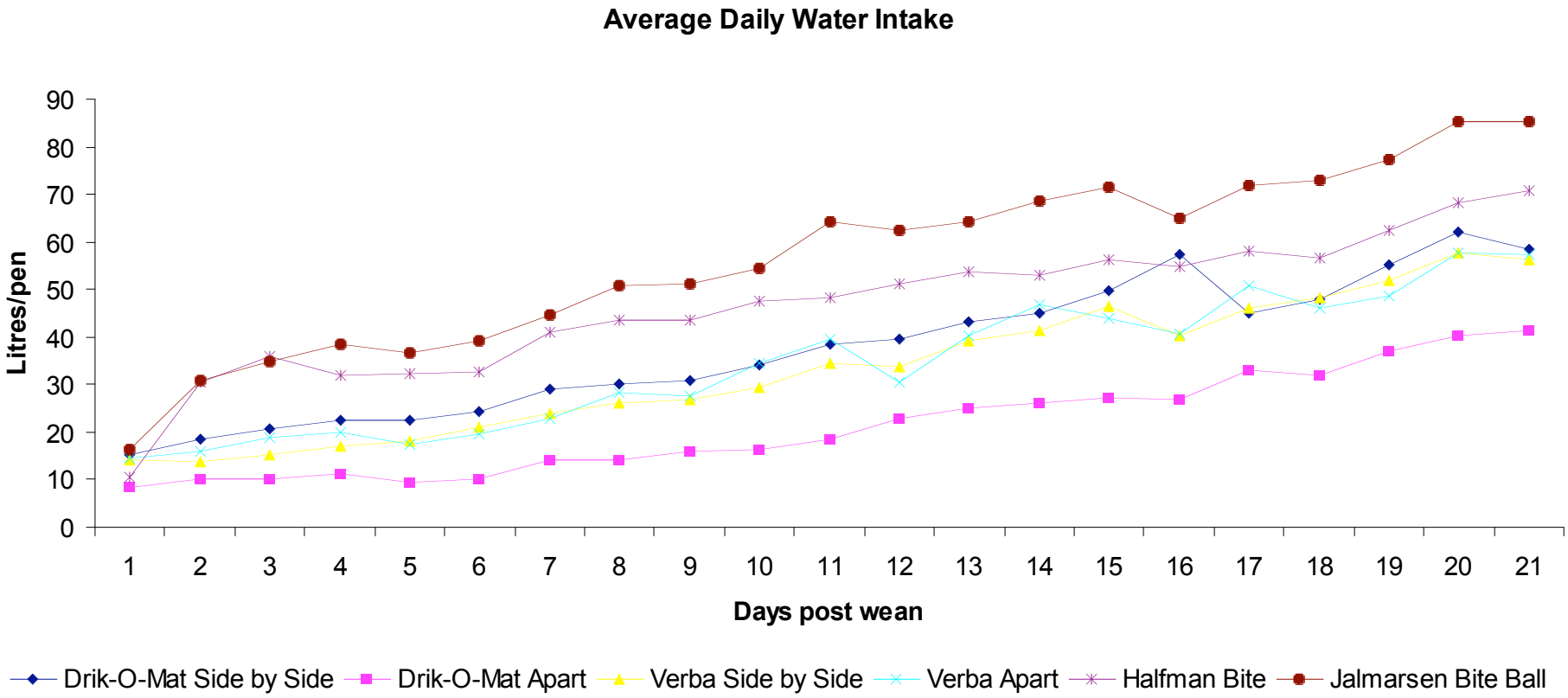
Numbers with common superscripts are not significantly different. *** P<0.001, ** P<0.01

Table 4 Average daily water intake of post weaned pigs (litres/pig/day) offered water from different drinker designs in different positions

Days after weaning	Drik-O-Mat Side by side	Drik-O-Mat Apart	Verba Side by side	Verba Apart	Halfman Bite	Jalmarsen Bite Ball	Sem	Sig
1	0.754	0.417	0.707	0.720	0.528	0.813	0.123	NS
2	0.930^{a}	0.514^{a}	0.686^{a}	0.792^{a}	1.52^{b}	1.53^{b}	0.200	**
3	1.03^{a}	0.508^{a}	0.763^{a}	0.944^{a}	1.79^{b}	1.75^{b}	0.187	***
4	1.12^{bc}	0.558^{a}	0.861^{ab}	0.989^{ab}	1.59^{cd}	1.93^{d}	0.186	***
5	1.12^{b}	0.466^{a}	0.902^{ab}	0.867^{ab}	1.61^{c}	1.83^{c}	0.169	***
6	1.22^{bc}	0.503^{a}	1.06^{b}	0.971^{ab}	1.63^{cd}	1.96^{d}	0.174	***
7	1.45^{b}	0.699^{a}	1.20^{ab}	1.15^{ab}	2.05^{c}	2.24^{c}	0.202	***
14	2.25^{b}	1.31^{a}	2.07^{ab}	3.25^{c}	2.65^{bc}	3.43^{c}	0.286	***
21	2.91^{ab}	2.08^{a}	2.82^{ab}	2.88^{ab}	3.53^{bc}	4.26^{c}	0.341	**

Numbers with common superscripts are not significantly different. *** P<0.001, ** P<0.01, NS Not Significant

Figure 1 Average daily water intake (litres/day/pen (20 pigs)) of post weaned pigs offered water from different drinker designs in different positions



4.3 Behaviour

4.3.1 General usage of drinkers

The effect of treatment on the behaviour of pigs around the drinkers is reported in Table 5. No significant treatment differences were shown in the average proportion of scans where a pig was observed using the drinker (average value 0.07; P>0.05). The number of pigs apparently queuing for the 'Drik-O-Mat – Apart' drinker was greater than for all other drinkers except the 'Drik-O-Mat – Side-by-side' and the 'Verba – Apart' drinkers (P=0.05). There were more pigs standing in close proximity to (but not apparently queuing for) the 'Halfman' and 'Jalmarsen' drinkers than all other drinkers (P<0.01). More pigs were also observed nosing the floor under the 'Halfman' and 'Jalmarsen' drinkers than all other drinkers (P<0.001).

Analysis of bowl drinker design showed more pigs apparently queuing for 'Drik-O-Mat' than 'Verba' drinkers (P<0.05). There were no significant main effects of bowl drinker position, or interactive effects between bowl drinker position and design, on this parameter (>0.05).

4.3.2 Behaviour at drinkers

No significant treatment effects were shown on the average number of drinking bouts or the average length of drinking bouts (P>0.05) (Table 6). Pigs removed their heads from the drinker during drinking bouts more frequently with the 'Jalmarsen' than the 'Halfman' drinkers, and with both these drinker types than with all other drinkers (P<0.001). Fewer pigs switched drinkers during a drinking bout with the 'Drik-O-Mat – Apart' drinker than with all other drinkers except the 'Verba – Apart' and the 'Jalmarsen' drinker (P<0.05) (Table 6). Analysis of bowl drinker position showed that placing bowls apart rather than side-by-side led to a significant reduction in switching between drinkers (P<0.01). There was no significant effect of bowl drinker design, or interactive effect between bowl drinker design and position, on this parameter (P>0.05).

There was no overall treatment effect on the proportion of drinking bouts that ended with a pig leaving the drinker voluntarily (P>0.05) (Table 7). However, analysis of bowl drinker design showed a significant effect on this parameter, with more pigs leaving voluntarily with 'Verba' than with 'Drik-O-Mat' drinkers (P<0.05). There were no effects of bowl position, or interactive effects between bowl drinker position and design, on this parameter (P>0.05).

Table 5 Effect of treatment on the average number of pigs performing different behaviours during hourly scan observations over a 24 hour period

	Drik-O-Mat Side by side	Drik-O-Mat Apart	Verba Side by side	Verba Apart	Halfman Bite	Jalmarsen Bite Ball	Sem	Sig
Queuing for drinker	0.04^{bc}	0.05^{c}	0.02^{ab}	0.03^{abc}	0.02^{a}	0.02^{ab}	0.008	0.05
Within 1 m of drinker (but not queuing)	0.03^{a}	0.05^{a}	0.01^{a}	0.04^{a}	0.13^{b}	0.15^{b}	0.028	<0.01
Nosing floor beneath drinker	0.01^{a}	0.01^{a}	0.00^{a}	0.01^{a}	0.10^{b}	0.12^{b}	0.025	<0.01

Table 6 Effect of treatment on average length and number of drinking bouts, and the average number of times pigs removed their head from a drinker or switched between drinkers during a 10 minute observation

	Drik-O-Mat Side by side	Drik-O-Mat Apart	Verba Side by side	Verba Apart	Halfman Bite	Jalmarsen Bite Ball	Sem	Sig
No of drinking bouts	5.63	4.71	5.20	5.86	5.68	5.14	0.625	NS
Average length of bout(s)	8.06	6.89	7.88	8.52	8.61	10.46	1.321	NS
No of times pig removed head from drinker	0.36^{a}	0.20^{a}	0.25^{a}	0.14^{a}	0.77^{b}	1.54^{c}	0.138	<0.001
No of times pig switched between drinkers	0.52^{cd}	0.07^{a}	0.50^{bcd}	0.12^{ab}	0.75^{d}	0.33^{abc}	0.138	<0.05

NS Not Significant

Table 7 Effect of treatment on the proportion of drinking bouts which ended by different means

	Drik-O-Mat Side by side	Drik-O-Mat Apart	Verba Side by side	Verba Apart	Halfman Bite	Jalmarsen Bite Ball	Sem	Sig
Voluntarily	0.76	0.77	0.82	0.86	0.84	0.83	0.036	NS
Moved non-aggressively	0.05	0.06	0.04	0.02	0.04	0.10	0.022	NS
Moved aggressively	0.07	0.11	0.08	0.03	0.06	0.04	0.020	NS
Moved (aggressively or non-aggressively)	0.12	0.16	0.12	0.05	0.10	0.14	0.025	NS
Displaced non-aggressively	0.02	0.00	0.00	0.01	0.02	0.01	0.008	NS
Displaced aggressively	0.10^{c}	0.06^{abc}	0.05^{abc}	0.09^{bc}	0.04^{ab}	0.02^{a}	0.018	<0.05
Displaced (aggressively or non-aggressively)	0.13^{c}	0.07^{ab}	0.06^{ab}	0.09^{bc}	0.06^{ab}	0.03^{a}	0.019	<0.05

NS Not Significant

The highest level of displacements from the drinker was shown with the 'Drik-O-Mat – Side-by-side' drinkers, and this was significantly higher than for all other drinkers except the 'Verba – Apart' drinker ($P<0.05$) (Table 7). This appeared to be due primarily to a difference in aggressive displacements. There was a significant interactive effect between bowl drinker position and design on the proportion of drinking bouts that ended with pigs being displaced from drinkers. Placing drinkers apart rather than side-by-side led to significant reduction in this parameter with 'Drik-O-Mat' but not with 'Verba' drinkers ($P<0.05$). There was also a significant interactive effect between bowl drinker position and design on the proportion of drinking bouts that ended with pigs being 'moved' from drinkers. However in this case placing drinkers apart rather than side-by-side led to significant reduction in this parameter with 'Verba' but not with 'Drik-O-Mat' drinkers ($P<0.05$). This interactive effect was also shown with the proportion of drinking bouts that ended with pigs being 'moved aggressively' from the drinker ($P<0.05$).

5. DISCUSSION

The accessibility of water and hence drinker design is an important factor to consider in pig production since maximum feed intake and therefore growth performance is heavily reliant on an adequate water supply and quality (Barber *et al*., 1989). Inadequate flow rates from drinkers is one factor which can hinder water intake and therefore growth performance (Carroll, 2003). The DEFRA Code of recommendations for the welfare of pigs advises that the minimum flow rate from nipple drinkers should be 300 ml/min for newly weaned pigs, 500 ml/min for pigs up to 20 kg and 1 litre per minute for pigs up to 40 kg. No recommendations are given for Bowl drinkers.

In weaned pigs, water restriction through nipple drinkers has been found to decrease feed intake and growth performance and a water delivery rate of at least 450 ml/min was required to optimise production performance from 3 to 6 weeks of age (Barber *et al*., 1989). In this study the minimum flow rate from a nipple drinker was 600 ml/min and no difference was observed in production performance when flow rates were increased to 700 (Halfman Bite drinker) and 1200 ml/litre (Jalmarson Bite Ball drinker). This is in agreement with Barber *et al.* (1989) who found no improvement in growth performance when water delivery rate increased to 700 ml/minute. Different water flow rates appeared to influence behaviour, however. Behavioural results showed increased apparent queuing around Drik-O-Mat rather than Verba drinkers, which may suggest increased levels of competition (Walker, 1991). This is also supported by the fact that fewer drinking bouts ended with the pig leaving the drinker voluntarily with Drik-O-Mat than with Verba drinkers. However, apparent differences in competitive behaviour did not affect the length or frequency of drinking bouts between different drinker bouts.

In the current study the flow rate was a function of the drinker design and therefore a flow rate of 250 ml/min via the bowl drinkers was also found to be sufficient to maintain production performance of pigs, since there was no difference in the production performance of pigs offered water via the bowl drinkers and those offered water via the nipple drinkers. The design of the bowl drinkers encouraged pigs to release water from the nipple within the bowl but drink the released water from the

bowl, whereas water had to be drunk directly from the outlet of the nipple or ball drinkers.

The main difference between the drinker designs was the water used per pig. Although the Verba Nipple drinker had more than twice the flow rate of the bowl drinker, the water usage from the bowl and Verba Nipple drinkers was similar. However the flow rates from the Halfman and Bite ball drinkers were greater as was the water usage throughout stage 1 and stage 2 (4-10 weeks of age). Since no improvements were observed in production performance as a result of the greater flow rate it appears that the additional water was wasted and the majority of this wasted water would have been lost through the slatted floor, hence increasing the volume of slurry. When the water usage from the Halfman Bite drinker and the Jalmarsen Bite Ball drinker is compared with the water usage from the Verba nipple drinker placed apart, an extra 24,461 and 46,800 gallons of slurry or 17 and 32, 1500 gallon tanker loads of slurry extra would be produced respectively per year on a 200 sow unit. In light of current legislation it is in the interest of pig producers to minimise the volume of slurry produced due to restrictions on storage and disposal.

Behavioural observations showed greater numbers of animals gathered around the Halfman and Jalmarsen drinkers than other drinkers. More animals were also observed nosing the ground under these drinkers, and pigs removed their heads from these drinkers more frequently during drinking bouts than with other drinkers. It is possible that pigs used these drinkers for 'recreational' purposes (Walker, 1991) to a greater extent than other drinkers. This concurs with informal observations that showed that pigs released water from these drinkers onto the ground by pressing against them with their snouts or other parts of their bodies. Other pigs would then gather around to explore the wet area beneath the drinker. Previous research has shown that pigs are motivated to perform manipulative and exploratory behaviour (Beattie and O'Connell, 2002; Scott *et al*., 2006), and that they will redirect this behaviour towards penmates or the feeders in the absence of more appropriate stimuli (Beattie *et al*., 2001). The design of the Halfman Bite and Jalmarsen Bite Ball drinkers, whereby water nipples were not protected by a bowl and could be easily manipulated to release large amounts of water, may have lent them to being used for recreational purposes to a greater extent than other drinkers. This may explain greater apparent wastage of water from these drinkers.

Placing bowl drinkers apart rather than side-by-side led to a general reduction in the frequency of pigs swapping between drinkers. This concurs with studies of feeding behaviour which showed that placing feeders apart led to less swapping between feeders than placing them side by side (Walker *et al*., 1993). Although no interactive effect was shown, the reduction in swapping behaviour associated with placing drinkers apart was greater (and statistically significant) with Drik-O-Mat than with Verba drinkers. Previous research found that swapping between feeders led to increased spillage and therefore wastage of feed (Walker *et al*., 1993). Similarly, swapping between drinkers may lead to increased water wastage, and this may explain why placing drinkers apart appeared to lead to a reduction in water wastage in Drik-O-Mat but not Verba drinkers. The reason for the reduced swapping behaviour in Drik-O-Mat but not Verba drinkers is not clear, but it is possible that pigs are less inclined to relinquish their place at a drinker when lower water flow rates are used. Placing 'Drik-O'Mat' drinkers apart also led to less 'displacements' from the

drinker, which suggests that competition for the drinker was reduced (O'Connell *et al.*, 2002). Overall, however, placing bowl drinkers apart did not significantly affect the proportion of drinking bouts that ended with pigs leaving the drinker voluntarily.

Growth checks experienced post weaning are mainly a result of reduced feed intake. Reasons for a reduction in feed intake post weaning include the stress of movement and the entry to a very different type of housing and environment. This new type of housing/environment not only includes a new way of feeding but also usually a new method of drinking. It has been established that feed intake is correlated with water intake and therefore the lack of water intake may in many cases be the cause of reduced feed intake. Gill (1989) found that it could take a least a week for weaned pigs to restore daily fluid intake to the equivalent of that on the day before weaning. In this study, although water was used in the first day after weaning, it was found that no drinker design or position significantly increased or 'encouraged' water intake at this early stage. However during the second day after weaning, pigs used significantly more water from the Halfman Bite and the Jalmarsen Bite Ball drinkers than from the other drinker designs. This would suggest that these drinker designs encouraged pigs to drink. After day 2 post weaning the water usage within all treatments gradually increased at a similar rate which indicates that after 2 days all pigs had adapted to the drinker designs and positions.

6. CONCLUSIONS

- There was no significant difference between 4 and 10 weeks of age in growth rate, feed intake or feed conversion efficiency between the drinker designs or positions.
- Reduced water flow rates in bowl type drinkers led to increased competition at the drinker but did not affect the number or length of drinking bouts.
- Significantly more water was used between 4 and 10 weeks of age when it was offered via the Halfman Bite and Jalmarsen Bite ball drinkers compared to the Verba and bowl drinkers. Behavioural observations suggested that this was because Halfman Bite and Jalmarsen Bite Ball drinkers were used for recreational purposes to a greater extent than other drinkers.
- It is assumed that this extra water usage was a result of higher flow rates, was wasted and hence increased slurry volume.
- If this assumption is correct the use of the Halfman Bite and Jalmarsen Bite Ball drinkers, compared to the Verba nipple drinkers resulted in an extra 17 and 32 tanker loads of slurry produced per year respectively.
- Pigs appeared to adapt more quickly after weaning to the Halfman and Bite ball drinkers than the Verba and bowl drinkers.
- Placing Drik-O-Mat drinkers apart rather than side-by-side led to a reduction in water usage, and this appeared to be due to a reduction in swapping between drinkers.
- The fact that this effect was not observed with Verba drinkers suggests placing drinkers apart is more effective at reducing water wastage when lower water flow rates are used.

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