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Perch width preferences of laying hens

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Abstract 1. In order to investigate the effect of perch width on perching behaviour of laying hens, two experiments in which hens could choose between 7 different perch widths (1·5, 3·0, 4·5, 6·0, 7·5, 9·0 and 10·5 cm) were conducted. In one experiment (EXP-2P) test cages contained two long perches gradually broadening and narrowing stepwise, in the other experiment (EXP-7P) 7 separate short perches differing in width were placed in the test cages. In each experiment 12 groups of 4 hens were filmed during day and night. The behaviour and location of the hens were recorded and whether the nest box affected hen distribution over the perches was investigated.

2. During daytime, in EXP-2P, there was an increase in perch use with increasing perch width. Hens spent less time on perches of 1·5 cm wide compared to perches of 9·0 and 10·5 cm wide. In EXP-7P, the 1·5-cm wide perch was also used the least (but only the difference with 4·5-cm wide perches was statistically significant) but perch use did not increase linearly with perch width. During the night, there were no significant perch width preferences in either experiment.

3. The percentage of active behaviours (preening, walking, drinking, pecking at hen) versus passive behaviours (standing, sitting, sleeping) did not differ significantly according to perch width.

4. In EXP-7P, there was a trend for perch use to decrease with greater distances to the nest box in the morning.

5. A perch width of 1·5 cm is not recommended for laying hens. For wider perch widths, results were equivocal: they tend to support rather than challenge the widespread use of 4·5-cm wide perches in commercial units.

INTRODUCTION

The design of housing systems for laying hens has an important effect on their behaviour and health. According to EU-Directive 1999/74/EC, from 2012 onwards all housing systems should be provided not only with nest boxes and litter but also with perches. Perches are heavily used during both night (Abrahamsson and Tauson, 1993; Wall *et al.,* 2002) and day (Tauson, 1984; Channing *et al*., 2001). Furthermore, hens are motivated to access a perch for roosting at night (Olsson and Keeling, 2002). Various perch design features influence perch use such as shape (Muiruri *et al.,* 1990), arrangement (Oden *et al*., 2002; Wall and Tauson, 2007; Struelens *et al*., 2008*a*), height (Struelens *et al*., 2008*b*) and length per hen (Duncan *et al*., 1992). In commercial farms, often perches of 4·5 cm wide are used. However, it is also reported that hens roost on wider perches (Faure and Jones, 1982) or platforms (Hanssen, 1994; Oden *et al*., 2002) or on narrow structures like the drinker line (Lambe and Scott, 1998). Although some assume that perch width is not an important feature with regard to perch use (Appleby *et al.,* 1998), there is

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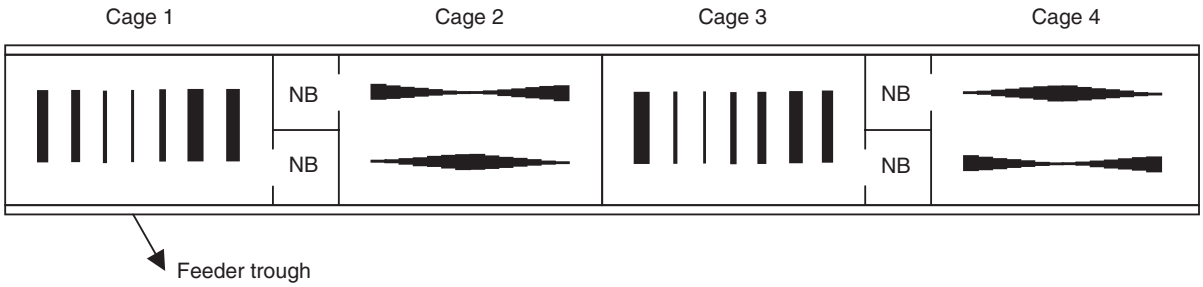

Figure 1. *Top view drawing illustrating the positions of the perches in the 4 test cages (NB: nest box).*

little systematic research on hens' preference for perch width. Appleby *et al.* (1998) compared rectangular perches of 3·8 cm wide to perches of 6·0 cm wide. They found no difference in perch use by laying hens in a preference test during daytime, although hens perched less on 3·8 cm perches compared to 6·0 cm perches in one trial offering one perch width at a time. Muiruri *et al.* (1990) found that broiler breeder hens strongly selected round metal pipe roosts of 5·0 cm diameter over 3·8 and 2·5 cm diameter roosts.

Dominant activities on the perches are preening, sitting and resting (Appleby and Duncan, 1989; Appleby *et al.*, 1992; Duncan *et al.,* 1992), although, to our knowledge, there is no previous study investigating whether behavioural time budgets are influenced by perch width. Besides the above features, the presence and location of other facilities can affect perch use. For example, perches positioned near drinkers or feeders can be heavily used while drinking or feeding (Duncan *et al.*, 1992).

The objectives of this study were (i) to investigate the preference of laying hens for different perch widths during day and night, and (ii) to study the behavioural time budgets of hens on perches varying in perch width during daytime. Because it is known that the experimental design of preference tests can affect the results (Dawkins, 1983), these objectives were studied in two different experimental designs: one similar to commercial conditions with perches positioned parallel to the feeder trough and one with perches perpendicular to the feeder trough.

MATERIALS AND METHODS

Animals and experimental designs

Ninety-six medium hybrid Bovans Goldline laying hens were used in this study. They were reared commercially in a deep litter system (without perches) and arrived at the test station at 17 weeks of age. In the test station, they were housed in conventional wire cages in groups of three hens until the start of two experiments (EXP-2P and EXP-7P). Both experiments were conducted at the same time and in the same test room. Forty eight laying hens were used in each experiment.

The test room accommodated 4 large cages (Figure 1), made of wire mesh with a floor slope of 7°, galvanised metal partitions between the cages and fully opening fronts at the long side of each cage consisting of widely spaced horizontal bars. The cages measured 240 × 110 cm (length × width). Each cage had a single nest box (60 × 55 cm) attached to the main cage. The wire roof of the main cage was removed to enhance the quality of the video recordings. The cage walls were raised to prevent the hens escaping. In the middle of the cage, a plastic air vent was present which was covered with triangular-shaped wire mesh to reduce its attractiveness as a perch.

Two cages in the test room were used for EXP-2P and two for EXP-7P. In both experiments 7 different perch widths (1·5, 3·0, 4·5, 6·0, 7·5, 9·0 and 10·5 cm) were offered at the same time and in an equal amount (60 cm per perch width) to the laying hens but in a different experimental design. In experiment EXP-2P, each cage was fitted with two long perches (210 cm) parallel to the feeder trough. Both perches consisted of 14 pieces that were 15 cm long. Each piece had a different perch width (cages 2 and 4 in Figure 1). One perch had the biggest width of 10·5 cm at the ends of the perch and gradually narrowed towards the middle. The other perch was constructed in the opposite way with perch width increasing stepwise from the extremities (1·5 cm) towards the middle (10·5 cm). In experiment EXP-7P, each cage had 7 separate perches 60 cm long positioned perpendicular to the feeder troughs. These 7 perches differed in width (ranging from 1·5 to 10·5 cm). All perches in both experiments were made of wood, were 1·5 cm high, had rounded top edges and were placed 12 cm above the cage floor.

Feed and water were available *ad libitum*. Feed was provided in a feeder trough at both sides of the cages and water by 4 nipple drinkers in the middle of the cage. Light schedule was 16 h L:8 h D (5 min subdued lighting during transitions). Subdued light onset was at 03:55 h. Ambient temperature was maintained at 20°C.

Table. *Effect of perch width (cm) on mean time spent on the perches during day and night in EXP-2P and EXP-7P (mean ± SE)*

			Perch width							*P* value Friedman test	*P* value Page test
			1·5	3·0	4·5	6·0	7·5	9·0	10·5		
Day	EXP-2P	Morning	$7{\cdot}5 \pm 1{\cdot}8^{a}$	$13{\cdot}7 \pm 1{\cdot}9^{b}$	$14{\cdot}7 \pm 1{\cdot}8^{b}$	$13{\cdot}1 \pm 1{\cdot}7^{b}$	$13{\cdot}4 \pm 1{\cdot}9^{b}$	$17{\cdot}4 \pm 2{\cdot}4^{b}$	$20{\cdot}2 \pm 2{\cdot}4^{b}$	<0·01	<0·001
		Afternoon	$10{\cdot}3 \pm 2{\cdot}0$	$12{\cdot}6 \pm 2{\cdot}2$	$11{\cdot}5 \pm 1{\cdot}7$	$16{\cdot}1 \pm 2{\cdot}2$	$10{\cdot}8 \pm 1{\cdot}8$	$17{\cdot}7 \pm 2{\cdot}3$	$20{\cdot}9 \pm 3{\cdot}7$	NS	<0·05
		Total	$9{\cdot}1 \pm 1{\cdot}6^{a}$	$13{\cdot}4 \pm 1{\cdot}7^{ab}$	$13{\cdot}7 \pm 1{\cdot}5^{ab}$	$13{\cdot}9 \pm 1{\cdot}3^{ab}$	$12{\cdot}3 \pm 1{\cdot}4^{ab}$	$18{\cdot}5 \pm 1{\cdot}8^{b}$	$19{\cdot}1 \pm 2{\cdot}3^{b}$	<0·01	<0·001
	EXP-7P	Morning	$9{\cdot}4 \pm 2{\cdot}1^{a}$	$12{\cdot}5 \pm 1{\cdot}9^{a}$	$22{\cdot}6 \pm 2{\cdot}9^{b}$	$15{\cdot}1 \pm 2{\cdot}3^{ab}$	$10{\cdot}5 \pm 2{\cdot}1^{a}$	$14{\cdot}7 \pm 2{\cdot}3^{ab}$	$15{\cdot}2 \pm 2{\cdot}1^{ab}$	<0·01	NS
		Afternoon	$10{\cdot}4 \pm 2{\cdot}1$	$14{\cdot}9 \pm 2{\cdot}5$	$16{\cdot}5 \pm 2{\cdot}1$	$13{\cdot}6 \pm 2{\cdot}4$	$13{\cdot}7 \pm 2{\cdot}6$	$15{\cdot}5 \pm 2{\cdot}3$	$15{\cdot}4 \pm 2{\cdot}4$	NS	NS
		Total	$10{\cdot}0 \pm 1{\cdot}8^{a}$	$13{\cdot}8 \pm 1{\cdot}8^{ab}$	$18{\cdot}9 \pm 2{\cdot}0^{b}$	$14{\cdot}5 \pm 1{\cdot}6^{ab}$	$12{\cdot}6 \pm 1{\cdot}8^{ab}$	$14{\cdot}7 \pm 1{\cdot}7^{ab}$	$15{\cdot}5 \pm 1{\cdot}9^{ab}$	<0·05	NS
Night	EXP-2P	Night 5 + 7	$12{\cdot}5 \pm 4{\cdot}3$	$12{\cdot}5 \pm 4{\cdot}3$	$7{\cdot}3 \pm 3{\cdot}3$	$4{\cdot}7 \pm 2{\cdot}1$	$9{\cdot}9 \pm 3{\cdot}9$	$6{\cdot}8 \pm 3{\cdot}2$	$13{\cdot}0 \pm 4{\cdot}3$	NS	NS
	EXP-7P	Night 5 + 7	$9{\cdot}4 \pm 3{\cdot}8$	$8{\cdot}3 \pm 3{\cdot}8$	$12{\cdot}5 \pm 4{\cdot}6$	$10{\cdot}4 \pm 4{\cdot}2$	$10{\cdot}4 \pm 3{\cdot}9$	$14{\cdot}6 \pm 4{\cdot}7$	$7{\cdot}3 \pm 3{\cdot}6$	NS	NS

[1]Night 5: after 4 habituation days; night 7: after 6 habituation days.
Within a row, means without a common superscript differ ($P < 0{\cdot}05$).

Both experiments started when the hens were 18 weeks of age and ended 6 weeks later. Each week, 4 groups of 4 hens were assigned at random to one of the 4 test cages (Figure 1). The allocation of the 4 cages to the two different experimental designs rotated weekly. In EXP-2P, the two perches were also rotated for each test group so that each perch was positioned alternately in front of the nest box. In EXP-7P, positions of the 7 perches were changed at random (but with the limitation that each perch width occurred at least once and not more than twice at the end and in the centre of the cage) after each test group.

Observations

Hens were individually marked by clipping some of their feathers on different parts of their body. After 4 habituation days, hens were filmed during night (23:30–00:30) (night 5) and after 6 habituation days, hens were filmed during day (morning: 04:30–11:00 and afternoon: 14:00–19:30) and night (23:30–00:30) (night 7) using a camera with black and white film above each test cage. Infrared light sources switched on when lights were out which allowed filming hens in the dark. During the day, the location (cage floor, nest box, perch, air vent) and behaviour (standing, walking, sitting, sleeping, preening, eating, drinking, cage pecking, pecking at cagemate) of each individual hen were scored at 15-min intervals. For hens on a perch the width of the perch was recorded. During the night, the location (cage floor, nest box, perch) of the hens was recorded at 23:35, 00:00 and 00:25 h. For hens on a perch the width of the perch was recorded. During the behavioural observations, it was noticed that the position of the nest box possibly affected perch use. Therefore, the location of the hens on the perches was scored in relation to the distance to the nest box. This distance in EXP-2P was scored during the night using 14 levels (1: closest to the nest box – 14: furthest from the nest box) according to the 14 pieces of the perch. The distance in EXP-7P was scored during day and night using 7 levels (1: closest to the nest box – 7: furthest from the nest box) according to the position of the 7 perches.

Statistical analysis

The Friedman test with animal as stratification factor was used to test whether there was a difference in the use of different perch widths and different perch positions relative to the nest box. Perch widths were compared pairwise by the Wilcoxon rank sum test using Bonferroni's method to adjust for multiple comparisons (with comparison-wide significance level equal to $0{\cdot}05/21 = 0{\cdot}0024$). The Page test (Page, 1963) was used to assess whether there was a trend (increasing or decreasing) in perch use with increasing perch width and increasing distance from the nest box. Behaviour was categorised as either active (moving body: includes preening, walking, drinking, pecking at hen) or passive (motionless body: includes standing, sitting, sleeping) and activity was compared (as percentages) between the different perch widths using both Friedman and Page tests.

RESULTS

Perch width preference

Daytime

In both experiments, perch width had an effect on time spent on the perches during daytime. In EXP-2P, hens spent significantly less time on the 1·5-cm perches compared to wider perches in the morning (Table). In the afternoon, perch width had no effect on time spent on the perches. Combining morning and afternoon data, it was

found that hens spent only half as much time on perches 1·5 cm wide as on those of 9·0 and 10·5 cm wide and that these differences were significant. The Page test revealed that there was an increase in perch use with increasing perch width during the morning and afternoon.

In accordance with EXP-2P, there was an effect of increasing perch width in EXP-7P on time spent on the perches in the morning but not in the afternoon. In the morning, more time was spent on the 4·5-cm perch than on the 1·5-, 3·0- and 7·5-cm perches. Combining all daytime data of EXP-7P, it was found that hens spent less time on the 1·5 cm perch compared to the 4·5-cm perch. In contrast with EXP-2P there was no general trend of elevated perch use with increasing perch width.

Night-time

In both EXP-2P and EXP-7P there was no significant effect of perch width on time spent on the perches during the night (Table).

Daytime behavioural time budgets on perches

In EXP-2P and EXP-7P, hens spent 47 and 51% of their time perching during the day. It was estimated that 56% of the total standing, 90% of the total preening, 95% of the total sitting, and 43% of the total walking behaviours were performed on the perches in EXP-2P, whereas in EXP-7P 66% of the total standing, 88% of the total preening, 93% of the total sitting and 15% of the total walking were performed on the perches. Standing (71%) was the dominant activity on all perch widths, followed by preening (15%). In both experiments, percentages of active (preening, walking, drinking, pecking at hen) (range: 17–30%) and passive (standing, sitting, sleeping) (range: 70–83%) behaviour did not differ significantly by perch width.

Perch position preference (relative to the position of the nest box)

Daytime

In EXP-7P, perch use during the day decreased with increasing distance from the nest box (morning + afternoon data: Page test: $P < 0{\cdot}05$). This relationship was determined by the morning data (Page test: $P < 0{\cdot}01$) rather than the afternoon data (Page test: $P = 0{\cdot}325$) (Figure 2). In the morning, perches closest to the nest box ($P < 0{\cdot}01$) and perches positioned third from the nest box ($P < 0{\cdot}01$) were used more than the perches positioned fifth from the nest box (Friedman test: $P < 0{\cdot}05$). In the afternoon,

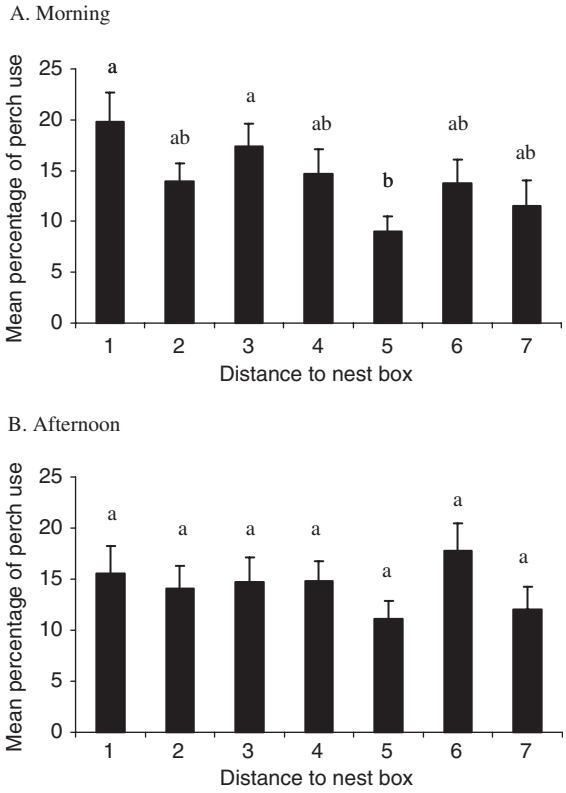

Figure 2. *Distribution of the hens on the perches according to distance to the nest box (1: perch closest to the nest box - 7: perch furthest to the nest box) in EXP-7P (mean ± SE). Means without a common superscript differ (*$P < 0{\cdot}05$*).*

there were no significant perch position preferences (Figure 2).

Night-time

In both EXP-2P and EXP-7P, perch use was not significantly affected by the distance of the perches to the nest box (EXP-2P: night 5: Friedman test: $P = 0{\cdot}629$, Page test: $P = 0{\cdot}234$; night 7: Friedman test: $P = 0{\cdot}959$, Page test: $P = 0{\cdot}933$; EXP-7P: night 5: Friedman test: $P = 0{\cdot}373$, Page test: $P = 0{\cdot}941$; night 7: Friedman test: $P = 0{\cdot}445$, Page test: $P = 0{\cdot}379$).

DISCUSSION

Results from both experimental designs indicate that during daytime hens avoid very narrow perches of 1·5 cm wide. In EXP-2P, perch use increased with perch width, whereas in EXP-7P perches of 1·5 cm wide were used significantly less compared to perches of medium width (4·5 cm) only. In the latter experiment, the allocation of the different perch widths relative to each other and to the position in the cage was randomised. In EXP-2P, however, perch width was partially confounded with perch position. For example, perch widths of 10·5 cm were only present at the ends of the perches or in the

middle of the perches and were always adjacent to perch widths of 9 cm. Because, for example, the distance from the nest box was shown to influence perch use in the morning, results of EXP-7P are probably more reliable. However, the advantage of the experimental design of EXP-2P is its similarity with practical conditions in which perches are often placed parallel to the feeder trough. Perhaps, it was also easier for the hens, once they were on the perch, to express potential perch width preferences without having to jump on and off 12-cm high perches. Although in the present experiments perches of 1·5 cm were the least preferred during the day, the behavioural time budget (the percentage of active versus passive behaviours) of hens on these perches did not differ significantly compared to wider perch widths.

During the night, no statistically significant perch width preferences were found. A preference for perch width during the day but not during the night is perhaps surprising because at night hens remain for long periods on a perch. It could be expected that if perch width influences perching comfort, it would matter mostly at night. On the other hand, behaviour on the perches is more active during the day which may require other perch features than during the night. Perches smaller than the length of the hens' feet – ca. 7 cm in the present study (data not presented) – allow the birds to clasp their feet around the perch. When the digits are in flexed position, a digital tendon locking mechanism consisting of tubercles on the tendons intermeshing with adjacent tendon sheath plications, prevents the digits from extending (Quinn and Baumel, 1990). This mechanism however seems to play no role in perch width preference during the night because perches less than 7 cm wide were not preferred to wider perches.

Analysis of the behavioural time budgets on the perches during the day indicated that birds did not alter their behaviour according to perch width. Approximately 70% of the time on the perches was spent standing which is higher than the 22% reported by Braastad (1990). In the present study, time spent preening (15%) and sitting (6%) on the perches are lower than in Braastad's (1990) study (26·5% preening, 20·8% sitting). However, we found that preening and sitting were almost exclusively performed on the perches, which is higher than in Braastad's study (1990), where 40% of preening and 49% of sitting was on a perch.

The unequal use of the perches according to their proximity to the nest boxes in the morning is not surprising as hens usually laid their eggs there in the morning. As a consequence, the area near the nest box was frequently used by laying hens inspecting the nest box and walking in and out the nest box.

We observed a large number of hens spending the night in the nest boxes (14·5% in EXP-2P and 35·2% in EXP-7P). Use of the nest boxes at night has also been reported in other studies, for example Tauson and Holm (2005) (0–15%), Cordiner and Savory (2001) (22·4%) and Valkonen *et al.* (2005) (11·5%). A possible explanation for the high use of nest boxes at night is the rearing experience of the hens, as it is known that the rearing condition can affect perch use later in life (Appleby and Duncan, 1989). Indeed, hens were reared without perches in the present study. Another explanation could be the extent of aggression between the hens. Cordiner and Savory (2001) hypothesised that the relatively high incidence of aggression in their experiment accounted for the use of nest boxes at night. It is known that mixing unfamiliar hens may cause aggression until a stable hierarchy is established (Appleby *et al.*, 2004). In our experiment, groups were formed when hens were placed in the test cages.

In conclusion, because in both experimental designs a perch width of 1·5 cm was least preferred by the laying hens during daytime, this perch width is not recommended. For wider perches, results from both experiments were equivocal. Perch use increased with increasing perch width in one experiment, but not in the second. In the latter there was a preference for 4·5-cm wide perches (which are used widely in commercial conditions) to 1·5-cm perches. However, time budgets on the perches did not reveal differences between the different perch widths. During the night, hens showed no perch width preferences. In determining the optimal perch width for laying hens, in addition to preference testing, long-term effects on health (for example the incidence of bumble foot and keel bone lesions (Tauson and Abrahamsson, 1994)) and hygiene should be evaluated. The position of the nest box affected hen distribution over the perches in the morning. Perches near the nest box were used more than perches further away.

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