To what extent can the age at sexual maturity of broiler breeders be reduced?

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Abstract

Two trials were conducted to investigate the effects of growth manipulation and early photostimulation on age at sexual maturity and, in one trial, subsequent laying performance, in broiler breeders. In the first trial, the possibility of reducing the age at sexual maturity, using early photostimulation and increasing the growth rate to achieve 2100 g at 15 weeks, was assessed. Sexual maturity was advanced by 15 d and the total number of eggs laid to 60 weeks, on a hen.week basis, was reduced significantly, by six. Mean egg weight was unaffected, but the number of unsettable eggs was increased by 2.6. Using 12 h rather than 16-h daylengths during the laying period resulted in a significant increase (7) in number of eggs laid. In the second trial, birds were transferred from 8 to 16-h daylengths at 10, 11, 12, 14, 16 or 18 weeks to determine the age at which they were able to dissipate photorefractoriness, and become photosensitive. Short-day controls were maintained on 8-h daylengths throughout. Birds were grown to achieve 2100 g at either 15 or 20 weeks. No interaction occurred between age at photostimulation and body weight. Because broiler breeders exhibit photorefractoriness, the earliest age at which the pullets responded to photostimulation was 14 weeks, so no advantage would be gained in terms of advancing sexual maturity by photostimulating earlier than this age. However, whilst some further advance in sexual maturity may be achieved by rearing the birds on a faster growth curve this would only be profitable through the advantages of being able to use one rearing unit to service three, instead of two, laying farms.

Keywords: Broiler breeder, photostimulation, growth curve, sexual maturity, egg production
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Introduction

Reproductive problems in broiler breeder females are often attributed to the intense selection pressure for weight and feed conversion, which has been carried out in these lines. However, it is possible that a significant amount of the failure to reach potential performance results from mismanagement or misunderstanding of the needs of the broiler breeder. Programmes for managing broiler breeders have evolved over time by adopting those management protocols that appeared to achieve the best performance, and by the use of management practices that work for laying hens, the latter particularly with regard to lighting programmes. Whereas this was possible for many years because the birds were grown on day-old-to-death farms (they were reared and brought into lay in the same house), subjective observations suggest that, despite the obvious changes in breeder performance as a result of the advances in broiler performance, there has been little change in management protocols.

There has been a move away from day-old-to-death housing to a rear-and-move production system, in which specialized rearing farms grow the birds to about 20 weeks, and then move them to the laying farm until depletion at about 60 weeks. Thus a system of 20 weeks rear plus cleanout period fitted well with a 40-week laying period plus cleanout – one rearing farm would supply two laying farms on a regular cycle. As a consequence, broiler breeder productive systems were fixed to a 20/21-week transfer, and utilisation of any genetic or management trends, designed to allow an advance in sexual maturity, were effectively prevented. However, if the birds were managed to permit earlier light stimulation, there could be considerable economic gains, and, potentially, beneficial influences for production and bird welfare. The next youngest age at which a management system could be made to work would be transfer and light stimulation at 15/16 weeks. This would present an opportunity for either earlier depletion than the current 60-65 weeks, or the possibility to achieve better persistency (Sharp *et al.*, 1992) from birds that had not been subjected to the stringent body weight control currently applied. If successful, this would allow three batches of pullets to be raised in rearing houses each year.

Previous attempts to bring broiler breeders into early maturity have met with little success. Leeson & Summers (1983) showed that sexual maturity occurred at around 20 weeks when birds were grown more quickly and photostimulated when they achieved an arbitrary body weight of 2100 g. However, those birds were able to achieve an earlier maturity because 2100 g represented a higher proportion of their mature body weight than would be the case in modern genotypes. Yuan *et al*. (1994) investigated the possibility of reducing rearing costs and maximising settable egg production by subjecting broiler breeders to early photostimulation after allowing them to achieve heavier than normal body weights. However, data from this trial are not completely reliable due to the several confounding factors that were not accounted for, which make it difficult to draw any useful conclusions from the results.

Recent evidence demonstrating that broiler breeders exhibit juvenile photorefractoriness (Lewis *et al*., 2003; Gous & Cherry, 2004) would suggest that there is a lower limit to the age at which broiler breeders might be brought into lay, which is defined by the rate at which photorefractoriness is dissipated in these birds. However, growth rate also appears to influence age at sexual maturity, with faster-growing birds consistently maturing about 10 d earlier than conventionally-grown pullets (Lewis *et al*., 2004). In determining the extent to which maturity might be reduced in broiler breeders, the effects of the rates of both the dissipation of photorefractoriness and body weight gain need to be considered. These two controlling factors formed the basis of the research reported here.

Two trials were conducted. The first, in which the birds were housed in groups in floor pens, investigated the possibility of reducing the age at sexual maturity by photostimulating five weeks earlier than the conventional 20 weeks and modifying the growth curve to achieve 2100 g at 15 weeks. An added objective of this trial was to investigate the effects of 12 and 16-h daylengths during the laying period on laying performance. In the second trial, birds were housed in individual cages and transferred from 8 to 16-h daylengths at 10, 11, 12, 14, 16 or 18 weeks to determine when they become photosensitive. Some birds were maintained on 8-h daylengths as short-day controls. Additionally, the birds were grown to achieve 2100 g at either 15 or 20 weeks to investigate possible interactions between age at photostimulation and body weight.

Materials and Methods

In Trial 1 a light-tight rearing facility was used to rear 4000 females and 560 males (Cobb 500, Cobb Breeders South Africa). The females were placed separately in eight rooms, each room being divided into two pens (16 pens in total), at a stocking density of 12 birds/m^2. Males were housed initially in two pens in one room, with half of the birds being moved to an adjacent room at four weeks. At nine weeks, 3200 females were moved into the laying facility, while the remaining pullets were moved to cages, to be used for Experiment 2. The laying facility comprised eight light-tight rooms, each room being sub-divided into four pens (32 pens in total). Males, reared separately, were mixed with the females when the average egg production for a room reached 5 eggs/100 bird d. Ten males were placed with 100 females in each pen, at a stocking density of 5 birds/m^2. Feed was provided on a daily basis at 07:00. The experiment was terminated when the birds reached 60 weeks of age. Details of the treatments used in this experiment are given in Table 1.

Table 1 Details of the experimental treatments used for Trial 1

Growth	Age at photostimulation (weeks)	Daylength (h)	Pens (n)	Birds / pen
F	15	12	4	100
F	15	16	8	100
C	20	12	8	100
C	20	16	4	100

Two growth curves were applied to test the hypothesis that sexual maturity in broiler breeder pullets could be advanced by photostimulating them five weeks earlier than those on a commercial management programme if the rate of body weight gain during rearing was increased. Half the birds (16 pens) were reared on the growth curve recommended by the primary breeder (Cobb 500 management guide, 2001), the target body weight at 20 weeks being 2100 g (Control), while the remaining pullets were reared on a growth curve (Fast) designed to achieve 2100 g at 15 weeks. Target body weights for both growth profiles and deviances from these are given in Table 2.

Birds were fed a commercial broiler starter crumble (191 g CP/kg, 10.4 MJ AMEn/kg, 12 g Ca /kg) to three weeks, a broiler breeder starter pellet (198 g CP/kg, 11.0 MJ AMEn/kg, 12 g Ca/kg) from four to six weeks, a broiler breeder grower pellet (177 g CP/kg, 11.2 MJ AMEn/kg, 11 g Ca/kg) from seven weeks to a rate of lay of 5 eggs/100 bird d, and thereafter broiler breeder layer pellets (142 g CP/kg, 11.1 MJ AMEn/kg, 28 g Ca/kg) until the end of the trial at 60 weeks. During the rearing period the daily feed allocation for each treatment was revised weekly, taking into consideration the average body weight gained in the previous week (mean of a 0.3 sample weighed with empty crops) and the body weight required to be achieved by the end of the succeeding week.

Table 2 Mean weekly body weight of pullets subjected to different growth curves (Control and Fast) to 20 weeks. Deviations from target weights are given in parentheses

Age (weeks)	Control growth (g)	Fast growth (g)
1	100 (-20)	101 (-19)
2	247 (-13)	249 (-11)
3	447 (+47)	540 (-20)
4	639 (+119)	774 (+44)
5	745 (+125)	892 (+12)
6	784 (+64)	961 (-60)
7	866 (+46)	1047 (-113)
8	992 (+2)	1154 (-136)
9	1040 (+20)	1311 (-109)
10	1151 (+31)	1503 (-38)
11	1237 (+17)	1630 (-10)
12	1314 (+14)	1805 (+65)
13	1389 (+9)	1986 (+126)
14	1483 (+43)	2103 (+103)
15	1564 (+44)	2234 (+64)
16	1673 (+73)	2318 (-32)
17	1742 (+42)	2465 (-55)
18	1856 (+36)	2598 (-82)
19	1931 (-29)	2724 (-106)
20	2123 (-37)	2817 (-133)

The chicks were given 22-h photoperiods for the first two days, 18-h photoperiods for days 3 and 4, and 14-h photoperiods for days 5 and 6. On day 7, daylength was decreased to 8 h and maintained until photostimulation at 15 (Fast) or 20 (Control) weeks (Table 1). At these respective ages, birds were transferred abruptly to either 12 or 16-h photoperiods.

All eggs laid were recorded daily to 60 weeks. Abnormally large, obvious double-yolked, and soft-shelled eggs were recorded, but not weighed. Settable eggs were considered to be those weighing more than 50 g, single yolked and with no shell abnormalities. These eggs were weighed on three consecutive days each week. Age at sexual maturity (ASM) was defined as the age at which mean rate of lay for a 2-d period first exceeded 50 eggs/100 bird.d.

The experiment was designed as a 2 x 2 factorial with two growth-curve/photostimulation-ages (Control *vs.* Fast) and two daylengths from photostimulation (12 *vs.* 16 h), with two replications (four pens of 100 hens in each replication) of each treatment combination. However, because of an error made to two of the rooms whilst adjusting the lighting programmes at 15 weeks, only one replication of the Fast, 8 – 12 hr and the Control, 8 – 16 hr treatments could be used. The design of the experiment was therefore unbalanced, and so data for the remaining six rooms were analysed using REML (Residual maximum likelihood model) from Genstat 6th Edition (Lawes Agricultural Trust, 2002), using Growth-curve* Photoperiod as the fixed model, and Growth-curve.Photoperiod.Room as the random model. Significant differences ($P \leq 0.05$) between means were identified using the appropriate s.e.d. and a Student's *t*-test.

In Trial 2 the broiler breeder pullets used (240) were randomly selected at nine weeks from each of the two growth curve treatments described above and moved into individual cages in eight light-tight rooms, each room housing 30 birds from each of the two growth profiles. The growth profiles and feeds used for this trial were the same as described for Trial 1. Pullets in two rooms were maintained on 8-h photoperiods throughout the trial, while those in the six remaining rooms were given an abrupt increase in daylength, from 8 to 16 h, at 10, 11, 12, 14, 16 or 18 weeks. The age at which a bird laid its first egg was used as the definition of sexual maturity (ASM). The weight of the first egg and the body weight of the hen on that day were both recorded. At 52 weeks, all birds that had not laid an egg were euthanased to examine the state of the reproductive tract. These data were analysed with REML, because the design of this experiment was unbalanced, using Growth-curve*Photostimulation-age as the fixed model, and Growth-curve.Photostimulation-age.Room.Bird as the random model. Significant differences ($P \leq 0.05$) between means were identified using the appropriate SED and a Student's *t*-test. Simple linear regression with groups, using Genstat 6th Edition (Lawes Agricultural Trust, 2002), was used to determine differences in slope and intercept between the two body weight classes.

Results

In Trial 1 the ASM (mean of 12 and 16-h groups) for birds on the Fast treatment occurred 15 d significantly earlier, but total egg numbers to 60 weeks were six eggs significantly fewer, than those on the Control treatment (Table 3). There was a further significant 3-egg reduction in the number of settable eggs for the Fast group as a result of an increase in the number of eggs rejected due to inferior size or shell faults. There were no significant differences between treatments in mean egg weight to 60 weeks.

Table 3 The effects of growth curve and photoperiod in lay on age at sexual maturity (ASM), total and unsettable egg numbers, and mean egg weight of broiler breeder hens to 60 weeks of age (Trial 1). Pen numbers are given in parentheses

Growth	Photoperiod	ASM (d)	Total eggs (hen.week basis)	Unsettable eggs (hen.week basis)	Mean egg weight (g)
Control	12 (8)	183	160	0.22	65.4
	16 (4)	182	150	0.21	65.2
Fast	12 (4)	168	151	2.81	65.0
	16 (8)	167	146	3.18	65.1
s.e.d.	Average	1.1	4.1	0.29	0.31
	Max	1.3	4.8	0.33	0.36
	Min	0.9	3.4	0.25	0.25
Main effects					
Growth	Control (12)	182	155	0.22	65.3
	Fast (12)	167	149	2.99	65.0
	s.e.d.	0.8	2.9	0.20	0.22
Photoperiod	12 (12)	175	155	1.52	65.2
	16 (12)	174	148	1.69	65.2
	s.e.d.	0.8	2.9	0.20	0.22

Residual d.f. = 20.

The ASM was not significantly different for the 12 and 16-h daylengths, but the birds on the 12-h daylength laid seven eggs significantly more than those on 16-h (Table 3). There was no significant difference in the number of unsettable eggs or mean egg weight to 60 weeks between the two daylengths. No significant interactions were found between the growth curves and the daylengths in lay for any of the variables studied. Mortality rates were similar for all treatment groups, being 8.8, 8.8, 7.8, and 6.0% from 20 to 60 weeks (for Fast-12, Fast-16, Control-12 and Control-16 respectively).

The mean body weights at photostimulation and at sexual maturity, together with mean ASM for each treatment, in Trial 2 are presented in Table 4. The latter three variables were significantly affected by the growth curve applied and by age at photostimulation. Mean body weight at sexual maturity, over all lighting treatments, was 200 g heavier for birds on the Fast growth curve, and the difference in ASM between the growth treatments over all lighting treatments was 25 d, but there was no interaction between growth curve and lighting treatment: simple linear regression with groups produced significant linear relationships between body weight at sexual maturity (y) and age at sexual maturity (x), the common slope beween growth curves being 14.2 ± 1.35 g/d but with intercepts differing significantly by 572 g (Figure 1). Similarly, the period between photostimulation and sexual maturity (y), although differing significantly between the two growth rate treatments, the intercepts varying by a significant 27.7 d (Figure 2) produced the same slope for both treatments (-1.73 ± 0.18 d/d) when regressed against age at maturity (x).

The initial weight of the eggs (Table 4) produced by the Fast birds was 3.6 g lighter than those produced by birds on the Control curve. Figure 3 illustrates that the mean egg weights for the two Growth Curve treatments to 30 weeks were the same when the Control pullets started laying, at 23 weeks, but then diverged to a maximum at 25 weeks before slowly converging again over the following five weeks.

Compared with the constant 8-h controls, birds transferred to 16 h at 11 or 12 weeks matured approximately 10 d later, but birds photostimulated at 14 and 16 weeks matured 18 d earlier, and those photostimulated at 18 weeks matured 33 d earlier. ASM of pullets that had been photostimulated at 10 weeks was not significantly different from the constant 8-h controls. Birds photostimulated at 18 weeks had the lightest body weight at sexual maturity and produced the smallest first eggs. There was no significant difference between body weight at sexual maturity for the constant 8-h control group and the groups photostimulated at 10, 11 or 12 weeks. However, all were significantly heavier than the birds photostimulated at 14 and 16 weeks, which were, in turn, significantly heavier than the 18-week-stimulated group. Eggs laid by pullets photostimulated at 18 weeks were 3 g significantly lighter than those of birds photostimulated at 14 and 16 weeks, which were in turn significantly lighter than those laid by the constant 8-h controls and birds transferred to 16-h photoperiods at 10, 11 or 12 weeks.

Discussion

Trial 1 was designed to investigate the effects on sexual maturity and subsequent laying performance of advancing photostimulation by five weeks whilst manipulating the growth curve to achieve the same target body weight at photostimulation as recommended for conventional broiler breeder management (2100 g at 20 weeks). Although the birds on the Fast growth curve, photostimulated at 15 weeks, reached sexual maturity sooner than the Controls that had been photostimulated at 20 weeks, the lag between photostimulation and sexual maturity was 28 d longer. Lewis *et al*. (2005) reported a 5 d earlier sexual maturity for a 10 d advance in age at 2.1 kg on constant daylengths, which is a more rapid response than that measured here (5 d earlier for a 14 d advance in age at 2.1 kg). When the birds were photostimulated at different ages, but at the same body weight, ASM was advanced by 15 d following photostimulation at 15 compared with 20 weeks. However, this response slope of a 0.43 d advance in maturity for each 1 d earlier photostimulation (15 d earlier ASM for 35 d earlier photostimulation) is a smaller response than would have been predicted from the model of Lewis *et al*. (2002) for egg-type hybrids transferred from 8 to 12 or 16-h photoperiods. Whilst the fact that the egg-type hybrids were fed *ad libitum* and broiler breeders are feed-restricted might suggest a nutritional explanation for the disparity, the difference in amplitude of response between the two types of bird could also be due to genetic differences, because Lewis *et al*. (1997) reported different responses for white and brown-egg-laying hens given the same increment in photoperiod. In contrast, the similarity in ASM in response to the two increases in photoperiod given at 20 weeks (8 to 12 h and 8 to 16 h) is not surprising, because the saturation daylength for gonadotrophin release in broiler breeders, although in a dwarf strain, has been observed to be about 12.5 h (Dunn & Sharp, 1990). It seems that 12 and 16-h daylengths are almost equally stimulatory for initiating rapid gonadal development in broiler breeders.

Table 4 The effects of growth curve and age at photostimulation (PHO) on mean (±s.e.m.) age at sexual maturity (ASM), body weight at PHO and at sexual maturity (SM) and initial egg weight of broiler breeder hens (Experiment 2). Bird numbers are given in parentheses

Growth curve	PHO (weeks)	ASM (d)	Body weight at PHO (g)	Body weight at SM (g)	Initial egg weight (g)
Control	Constant 8 h (55)	212 ± 3.2	*	3796 ± 58	54.9 ± 1.2
	10 (26)	219 ± 4.3	1061 ± 33	3824 ± 65	57.4 ± 1.2
	11 (28)	235 ± 4.6	1153 ± 39	4017 ± 79	57.4 ± 1.9
	12 (25)	223 ± 5.8	1386 ± 42	3816 ± 94	55.8 ± 1.3
	14 (28)	218 ± 4.5	1481 ± 22	3763 ± 64	55.2 ± 1.3
	16 (29)	201 ± 4.4	1643 ± 20	3587 ± 89	54.5 ± 1.7
	18 (29)	179 ± 1.6	1793 ± 12	3124 ± 46	48.0 ± 1.1
Fast	Constant 8 h (54)	202 ± 4.4	*	4259 ± 64	55.1 ± 1.3
	10 (27)	195 ± 5.4	1375 ± 76	4067 ± 89	54.8 ± 1.8
	11 (26)	197 ± 7.5	1625 ± 49	4035 ± 92	53.8 ± 2.0
	12 (21)	212 ± 11.4	1672 ± 46	4114 ± 122	54.8 ± 1.9
	14 (28)	161 ± 4.3	1965 ± 26	3532 ± 84	45.0 ± 1.3
	16 (26)	176 ± 6.2	2256 ± 63	3692 ± 80	48.2 ± 1.6
	18 (29)	168 ± 3.7	2388 ± 54	3739 ± 74	45.8 ± 1.0
s.e.d.	Average	6.81	62.3	104.1	1.97
	Max	7.59	63.7	116.1	2.19
	Min	4.91	62.0	75.2	1.42
Main effects					
Growth curve	Control (220)	212	1420	3704	54.7
	Fast (211)	187	1880	3920	51.1
	s.e.d.	2.58	37.6	39.5	0.75
PHO	Constant 8 h (109)	206	*	4028	55.0
	10 (53)	207	1218	3946	56.1
	11 (54)	216	1389	4026	55.6
	12 (46)	217	1529	3965	55.3
	14 (56)	189	1723	3647	50.1
	16 (55)	188	1949	3640	51.4
	18 (58)	173	2090	3431	46.9
	s.e.d.	4.82	64.5	73.7	1.39

Residual d.f. = 417

A consequence of the longer period between photostimulation and sexual maturity was that the birds consumed an additional 1.3 kg feed to point of lay resulting in body weight at sexual maturity being heavier for this group than for the controls, and this might possibly have contributed to their inferior rate of egg production. However, it is interesting to note that the reduction in number of eggs laid on the Fast treatment was exactly the same as that when using 16 as opposed to 12 h light/d in the laying period. A modification of the feed allocation schedule to reduce body weight gain in the period between photostimulation and sexual maturity might be an approach worth pursuing to minimise the adverse effects of a management protocol designed to reduce age at sexual maturity. The consequent slower growth rate might also reduce the number of double-yolked eggs (Hocking, 1996).

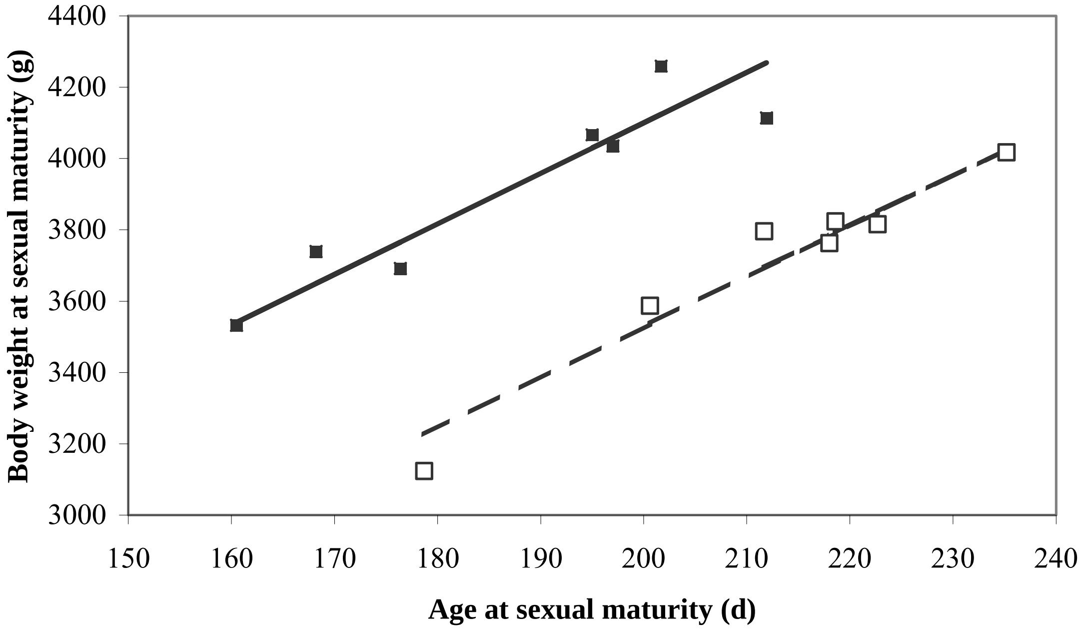

Figure 1 The relationship between age at sexual maturity (ASM) and body weight at sexual maturity of broiler breeder hens reared on Control (broken line, □) and Fast (solid line, ■) growth curves and kept on 8 h or photostimulated at different ages (Trial 2)

Figure 3 illustrates that the average egg weight for birds on the Fast growth curve was below the minimum setting-threshold weight of 50 g for approximately 25 d after the birds had started to lay, whereas with the Controls, this period was only 18 d; eggs of an acceptable size were produced by the Fast group by 23.5 weeks and by the Control group by 25.5 weeks. It is not clear from the evidence presented whether a revision of the provision of nutrients to the early maturing broiler breeder pullet prior to sexual maturation and in the initial part of the laying period would affect the reproductive performance of the pullets whose sexual maturity is to be advanced, but this may be worth considering.

Trial 2 was designed to identify the age at which broiler breeders dissipate photorefractoriness and thereby become photosensitive, and to assess the extent to which growth rate would influence this age. Such information is of relevance when investigating the opportunities for reducing age at sexual maturity in broiler breeders. Of greatest interest was the lack of an interaction between growth curve and lighting treatment imposed; Lewis *et al*. (2004) reported a similar result when using constant photoperiods of different lengths, at two body weights during rearing. This means that the extent to which age at maturity may be altered by each method may be predicted independently of the other method.

There would appear to be little or no advantage in photostimulating broiler breeder pullets before 14 weeks when attempting to reduce age at sexual maturity, as the evidence in Table 4 suggests that photorefractoriness would not have been dissipated before this age. Even where the growth rate is increased as a means of advancing age at maturity, the barrier imposed by the photorefractory condition prevents the pullets from responding to photostimuli until this age. Because photostimulation and body weight act independently when determining age at maturity, it may still be possible to reduce the age at maturity further by growing broiler breeders on a faster growth curve than used here, but no further advance will be possible with the use of photostimulation before about 14 weeks of age.

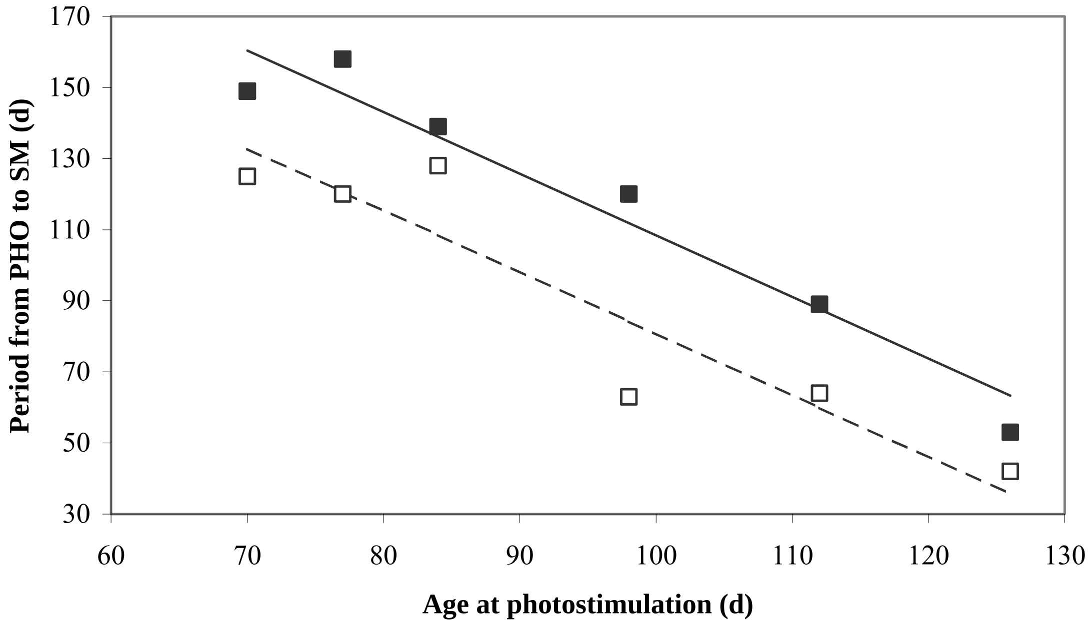

Figure 2 The relationship between age at photostimulation and the period from photostimulation (PHO) to sexual maturity (SM) for broiler breeders reared on a control (broken line, □) and on a fast (solid line, ■) growth curve (Trial 2)

Body weight at sexual maturity of birds on both growth curves was affected by the age at photostimulation. It is evident in Figure 1 that birds that achieved sexual maturity earlier had lighter body weights at sexual maturity, while those that were retarded, due principally to late photostimulation, were much heavier. This excess body weight gain between photostimulation and sexual maturity is partly the consequence of applying a common feeding programme to all the birds, irrespective of their age at maturity. This often occurs in commercial practice in out-of-season flocks reared in open sided houses, where feed allocations are increased at 15 weeks even though sexual maturity could be delayed by up to five weeks by the natural changes in photoperiod. Under such conditions the birds become excessively heavy before reaching sexual maturity and have inferior egg laying performance. As suggested before, new feeding strategies have to be researched to overcome this problem by avoiding large increments in body weight gain during this period.

Even though faster growth during the rearing period coupled with early photostimulation does not seem to be a feasible strategy at present, this study has shown that a reduction in the maximum daylength given to conventionally managed broiler breeders during lay will improve settable egg production. The significantly higher number of settable eggs produced by hens given a 12-h daylength in lay suggests that the recommendations of the primary breeders to provide a daylength of at least 16 h (Cobb 500 Breeder Management Guide, 2001) could be compromising the laying performance through a more rapid development of adult photorefractoriness (Lewis *et al.,* 2003). The rate at which adult photorefractoriness develops has been demonstrated to be proportional to photoperiod in non-domesticated avian species (Dawson & Goldsmith, 1983). Other supportive evidence is found in Sharp (1993), where broiler breeder hens given 11-h photoperiods, had better egg production than birds given 20-h photoperiods. A further contributing factor to the negative effect of long photoperiods could be a higher energy expenditure; birds at zero activity require 1 %/h more energy in light than in darkness (Lewis *et al.,* 1994). As a consequence, birds on 16 h have a higher maintenance requirement than birds on shorter daylengths, and, as a corollary, fewer nutrients are available for egg production.

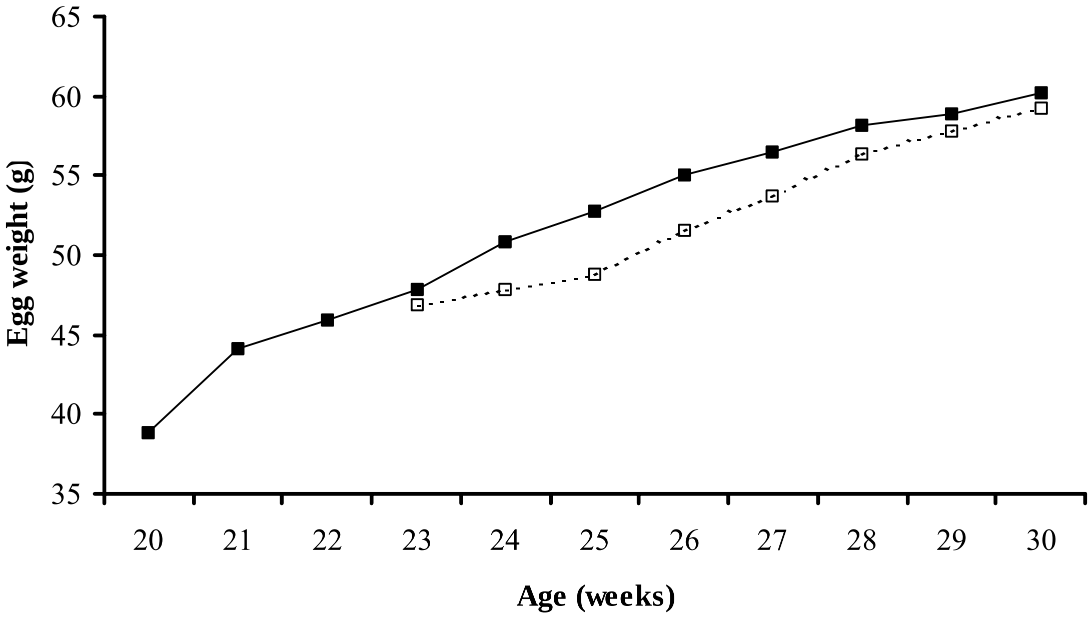

Figure 3 Mean weekly weights of eggs produced by broiler breeders reared on a Control (broken line, □) and a Fast growth curve (solid line, ■)

An important criterion to be considered before embarking on a novel management programme that modifies performance is the impact that this will have on the profitability of the enterprise. In this regard there are a number of factors that need to be considered, namely, the cost of implementing the new strategy in terms of infrastructure, changes in labour requirement, and hardware maintenance, together with any changes in the amount of feed required to get the birds to point of lay, and in rates of settable egg production, hatchability and mortality. Despite the important contribution that this research has made to the understanding of broiler breeder reproductive physiology, the advanced sexual maturation brought about by this novel husbandry technique resulted in fewer total and settable eggs and an increased production of reject eggs (due mainly to their weight being below the 50-g threshold for setting). However, if the rearing period could be shortened to 15 weeks, one rearing house would be able to supply point-of-lay pullets to three layer houses in a 60-65 week cycle, instead of two with the current practice of transferring at about 20 weeks. It would mean that one third of the rearing facilities could be made redundant, resulting in reductions in maintenance, land and labour costs. If fewer rearing farms could be maintained, the liberated capital could be used to improve the remaining facilities. This is particularly relevant in countries like South Africa where the majority of rearing houses are still open–sided. These could be converted into light-tight facilities that would improve the standard of rearing management of the pullets, and further increase the gross profitability of the enterprise.

Conclusions

These trials have demonstrated that age at sexual maturity in broiler breeder pullets can be significantly advanced with the use of earlier photostimulation and by growing pullets at a faster rate, these two interventions working independently of one another. Whilst it may be possible to advance sexual maturity further than demonstrated here, this would be possible only by growing pullets faster, as the constraint imposed by the photorefractory condition prevents broiler breeder pullets from responding to photostimulation prior to about 14 weeks of age. A reduction in the age at maturity, whilst using currently available feeds and feeding schedules, would only be profitable through the advantages gained in being able to use one rearing unit to service three, instead of two, laying farms. Because broiler breeders have been shown to exhibit photorefractoriness, a sensible change would be to invest in light-tight rearing houses, where short daylengths could be used, thereby allowing a more rapid dissipation of the condition. Where light-tight laying houses are available, the maximum daylength given to the hens during the laying period should be reduced, advantageously, below 16 h, resulting not only in a significant reduction in the cost of illuminating the birds, but also in a significant improvement in egg production. The results of these trials indicate that there are still opportunities to optimise ASM and performance through manipulations of age and body weight at photostimulation, and through a shorter photoperiod during the laying period.

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