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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

Reproductive Performance of Broiler Breeders as Affected by Age at Initiation of Laying Cycle Lighting Program

D.R. Ingram¹, L.F. Hatten, III and K.D. Homan
School of Animal Sciences, Louisiana Agriculture Experiment Station,
Louisiana State University, Agricultural Center, Baton Rouge, LA 70803, USA

Abstract: The control of lighting for broiler breeders is an extremely important aspect of controlling their reproductive performance. The length of light available to broiler breeder hens significantly effects the age at which they begin producing eggs and their subsequent peak egg production levels. Although most broiler breeders in the U.S. are grown in light-tight houses, in many areas of the world they are not and these producers must rely on natural daylight supplemented by artificial lighting. Therefore, it is important to understand the effects of delaying the age of initiation of artificial lighting programs when birds are grown under natural lighting conditions. In this experiment, June-hatched broiler breeders were grown under natural day length and artificial photostimulation was begun at either 18, 20 or 22 weeks of age. The results of this experiment showed that early egg production is decreased significantly in birds in which photostimulation has been delayed until 22 weeks of age. However, this significant decrease did not affect the overall egg production. This study indicated that delaying the artificial photostimulation of June-hatched broiler breeders until 22 weeks of age was not detrimental to their overall performance.

Key words: Broiler breeders, age of initiation, sexual maturity, performance

Introduction

Light is known to be a simulating factor of the reproductive system of the hen. Light stimulation induces an increase in the activity of the anterior lobe of the pituitary gland, which controls the release of the Follicle Stimulating Hormone (FSH). FSH in turn, stimulates the growth of the ovarian follicles which develop to produce eggs.

Light intensity must be adequate to induce an effect. The most important factor is the length of the light day available to the hen. Because length of natural daylight varies according to the location on the globe and according to season, the poultry industry can not rely on it. Using artificial light for layer hens and broiler breeder hens, therefore, has become routine.

The lighting program and, more important, the age of the hens when the lighting program is initiated, will determine the onset of sexual maturity and the peak of egg production. Egg production is therefore highly dependent upon the quality of the light management of the flock.

The response of female chickens to a specific photoperiod upon entering lay has been shown to be strongly dependent upon the photoperiod of the growing house (Morris, 1967; Ernst *et al.*, 1987; Lewis *et al.*, 1997). For broiler breeders, in addition to the high egg production goal, high fertility and hatchability of settable eggs are needed, as these factors will determine the number of usable chicks produced per hen. Currently, light restriction programs are utilized by the U.S. breeder

industry where birds receive light of low intensity for restricted day lengths. This has allowed for better control of the onset of sexual maturity and improved reproductive performance. However, in many areas of the world it is not possible to use these types of houses and more conventional programs must be used.

Broiler breeder management guides published by various primary breeders suggest ages from 18-21 weeks to begin artificial photostimulation for the laying cycle. Therefore, studies are needed to determine the age at which the broiler breeder hen should be given the proper amount of light to induce egg production and maximize profitability. The purpose of this study was to observe the effect of the age at lighting stimulation on broiler breeder performance parameters.

Materials and Methods

One thousand eight hundred females and 300 male Arbor Acres feather sexed broiler breeders hatched at the end of June, were reared together in a litter floored house and subjected to natural daylight until they were moved to the layer house. Birds were vaccinated against Marek's disease, Newcastle disease, avian encephalomyelitis and fowl pox.

At 16 weeks of age, 1200 females and 120 males were selected and transferred to the open sided litter floored layer house where 40 females were housed with 4 males per pen, in 30 pens measuring 6×2.75 m. Each pen was equipped with two 75-watt light bulbs placed 2.15 m from the floor to provide 2 foot candles of light at the floor level.

Ingram *et al.*: Broiler Breeder Lighting

Table 1: Mean Body Weight (kg) of Broiler Breeder Hens as Affected by Age at Photostimulation (PS)

Age at PS (weeks)	Age in Weeks										
	20	24	28	32	36	40	44	48	52	56	60
Body Weight (kg)											
18	2.0	2.5	2.9	3.2	3.3	3.4	3.5	3.5	3.6	3.7	3.7
20	2.1	2.6	3.0	3.4	3.4	3.5	3.5	3.6	3.6	3.7	3.7
22	2.0	2.6	2.9	3.3	3.4	3.5	3.5	3.5	3.5	3.6	3.6
P>F	0.81	0.79	0.83	0.69	0.71	0.62	0.89	0.62	0.85	0.88	0.69

Table 2: Egg Production (%HD) of Broiler Breeder Hens as Affected by Age at Photostimulation (PS)

Age at PS (weeks)	Age in Weeks									
	25-28	29-32	33-36	37-40	41-44	45-48	49-52	53-56	57-60	25-60
%HD										
18	16.1 ^a	71.3 ^a	84.6 ^a	80.1 ^a	78.5 ^a	72.9 ^a	69.4 ^a	65.1 ^a	61.9 ^a	66.6 ^a
20	15.8 ^a	70.0 ^a	84.3 ^a	79.9 ^a	78.0 ^a	73.2 ^a	69.2 ^a	65.3 ^a	62.1 ^a	66.4 ^a
22	12.3 ^b	68.2 ^b	82.1 ^b	80.3 ^a	79.1 ^a	73.4 ^a	70.1 ^a	66.2 ^a	62.7 ^a	66.1 ^a
P>F	0.03	0.05	0.03	0.35	0.72	0.69	0.58	0.43	0.51	0.62

a,b Means with different letters in the same column are significantly different (P<0.05).

Table 3: Egg Weight (g) as Affected by Age at Photostimulation (PS) of Broiler Breeder Hens

Age at PS (weeks)	Age in Weeks							
	33	37	41	45	49	53	57	61
Egg Weight (g)								
18	60.5	64.2	65.4	68.0	68.9	69.4	69.8	71.9
20	59.9	63.7	65.7	68.2	68.5	69.9	70.8	72.2
22	59.9	63.7	66.2	67.1	68.9	69.5	71.3	71.9
P>F	0.43	0.35	0.62	0.37	0.73	0.81	0.33	0.56

Blocks of 3 pens were subjected to the following treatments:

- At 18 weeks of age, pullets were given 14 hours of artificial light increased by 15 minutes weekly until 16 hours of artificial light per day was reached at 26 weeks of age (treatment 1)
- At 20 weeks of age, pullets were given 14 ½ hours of light increased weekly by 15 minutes, until 16 hours of artificial light was reached at 26 weeks of age (treatment 2)
- At 22 weeks, pullets were given 15 hours of artificial light per day with a weekly increase of 15 minutes until 16 hours of artificial light was reached at 26 weeks of age (treatment 3).

Extra males were maintained in separate pens on the same treatments for replacement of male mortality. Birds were fed according to the breeder's recommendation.

Female body weight was determined monthly. Egg production was recorded daily and summarized in 4 week periods beginning at 25 weeks. Fertility and hatchability data were collected on one week's eggs each 4 week period. Egg weight and egg specific gravity were measured on all eggs produced the following week of each 4 week period. Eggs were weighed to the nearest 0.1 g and specific gravity was determined by the floatation method.

All data were analyzed utilizing SAS in a randomized block design (SAS Institute, 2001). When significant treatment effects were found, they were separated by Duncan's multiple range test.

Results and Discussion

There was no significant treatment effect on female body weight (Table 1). The lack of significant effect of the age at lighting on body weight was expected because the birds were fed to maintain body weight in the range recommended by the broiler breeder management guide.

The group of hens subjected to artificial light at 22 weeks of age began laying at a significantly lower percent hen day rate that those stimulated at 18 or 20 weeks (Table 2). The rate of production in the 22 week group increased to a level where there was no significant difference among treatments by the fourth period (37-40 wks) and remained not significantly different from the other treatments. Over the entire experimental period, the age at lighting did not significantly affect egg production. This agrees with studies on White Leghorns that showed no effect of photostimulating hens at 17, 19 or 21 weeks of age (Lee and Zimmerman, 1986) or 15, 18 or 21 weeks of age (Leeson and Summers, 1980). Similar work with broiler breeders has shown a benefit to lighting at 20 weeks as opposed to 14 and 17 weeks but ages greater than 20

Ingram *et al.*: Broiler Breeder Lighting

Table 4: Egg Specific Gravity as Affected by Age at Photostimulation (PS) of Broiler Breeder Hens

Age at PS (weeks)	Age in Weeks							
	33	37	41	45	49	53	57	61
Specific Gravity ¹								
18	86.1 ^a	88.5 ^a	86.6 ^a	87.2 ^a	84.4 ^a	81.8 ^a	78.7 ^a	79.7 ^a
20	85.5 ^a	87.9 ^{ab}	86.2 ^a	86.8 ^a	83.9 ^a	81.7 ^a	79.4 ^a	78.4 ^a
22	86.1 ^a	87.0 ^b	85.9 ^a	86.3 ^a	83.7 ^a	81.3 ^a	78.4 ^a	78.2 ^a
P>F	0.64	0.04	0.35	0.42	0.47	0.38	0.55	0.32

¹Specific gravity = (tabular value x 0.001) + 1, a,b Means with different letters in the same column are significantly different (p<0.05)

Table 5: Fertility (%) of Eggs from Broiler Breeder Hens as Affected by Age at Photostimulation (PS)

Age at PS (weeks)	Age in Weeks							
	32	36	40	44	48	52	56	60
% Fertility								
18	93.3	95.3	96.0	94.3	92.6	91.2	89.6	86.7
20	93.3	95.1	96.1	94.7	92.5	91.3	89.6	87.1
22	92.7	95.1	96.0	94.4	91.9	91.3	89.8	86.9
P>F	0.72	0.69	0.76	0.52	0.57	0.68	0.71	0.48

Table 6: Hatchability (%) of Fertile Eggs from Broiler Breeder Hens as Affected by Age at Photostimulation (PS)

Age at PS (weeks)	Age in Weeks							
	32	36	40	44	48	52	56	60
% Hatchability								
18	97.2	97.9	98.4	98.0	96.9	96.2	94.6	89.9
20	96.9	97.6	98.3	98.0	97.3	96.6	93.7	89.7
22	97.5	97.8	98.3	97.8	96.7	96.2	94.2	90.4
P>F	0.63	0.61	0.70	0.47	0.49	0.61	0.69	0.44

Table 7: Total Hatchability (%) of Eggs from Broiler Breeder Hens as Affected by Age at Photostimulation (PS)

Age at PS (weeks)	Age in Weeks							
	32	36	40	44	48	52	56	60
% Total Hatchability								
18	90.7	93.2	94.5	92.4	89.7	87.7	84.7	77.9
20	90.4	92.8	94.5	92.8	90.0	88.2	84.0	78.1
22	90.3	93.0	94.4	92.3	88.9	87.9	84.6	78.5
P>F	0.61	0.54	0.62	0.43	0.49	0.53	0.62	0.43

weeks were not tested (Lien *et al.*, 1991). Other work has shown a benefit to lighting broiler breeders at 20 weeks as opposed to 16 weeks but no other ages were tested (Ingram *et al.*, 1988). It has been reported that delaying photostimulation of broiler breeders to 24 weeks significantly retarded sexual maturity, reduced total and settable egg numbers and increased egg white (Ciacciarriello and Gous, 2005). They also reported a tendency for fewer double yolked eggs when photostimulation was delayed to 24 weeks.

In this experiment, egg weight showed no significant treatment effect (Table 3), which agrees with a previous similar study using White Leghorn hens that showed no effect on egg size after 26 weeks of age with delay of photostimulation (Leeson and Summers, 1980) and other studies with broiler breeders (Lien *et al.*, 1991; Ingram *et al.*, 1988). Specific gravity was significantly affected in week 37 with the hens subjected to artificial

light at 22 weeks of age producing eggs with significantly lower specific gravity than those of the 18 week group (Table 4). However, this is the only period where such an effect was observed and there is no explanation for this result. For the entire experimental period, the age at lighting did not significantly affect egg specific gravity. Once again this seems to follow earlier findings that showed no effect on egg shell quality after 26 weeks of age with the delay of photostimulation in White Leghorn hens (Leeson and Summers, 1980) and no effect on egg specific gravity when broiler breeders were photostimulated at either 16 or 20 weeks of age (Ingram *et al.*, 1988).

Percent fertility was not significantly affected by treatment (Table 5). Hatchability of fertiles (Table 6) and total hatchability (Table 7) were also not significantly affected by age of light stimulation. These data are in agreement with previous work lighting broiler breeders at either 16 or 20 weeks of age (Ingram *et al.*, 1988).

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¹To whom correspondence should be addressed

Abbreviation key: PS = Photosimulation, FSH = Follicle Stimulating Hormone, HD = Hen Day