ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

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International Journal of Poultry Science 13 (7): 416-420, 2014
ISSN 1682-8356

Effect of Intermittent Lighting System on Some of the Productive Performance of Laying Hens

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Abstract: The research was conducted at Krabo modern research poultry house of Agriculture Faculty, Damascus University during August, 2011 till October, 2012. A total of 1512 one-day-old chicks of Babcock B-300-hybrid layer hens distributed randomly and equally into six groups with 3 replicates in the same group were housed until the age of 17 weeks in a closed house with deep litter and then transferred to the production house equipped with batteries of a three-tries until the age of 60 weeks in order to determine the effect of intermittent lighting on some of productive performance of laying hens. Chicks in the first group, G1 (control 1) were exposed to step down of lighting through the stage of growth and step up through the production stage In G2 (control 2), chicks were exposed to short constant step up lighting system while chicks in G3, G4, G5 and G6 were exposed to intermittent lighting-step up, step down intermittent, short constant-intermittent and intermittent-intermittent of lighting systems, respectively. Results showed that the application of the lighting system in G5 had no significant effect on the averages of mortality rate and the live body weight but birds showed significant earlier sexual maturity and improvement in the production of egg per hen compared with those of G1. Results also showed a significant decrease in the average of egg weight compared with G1 but significant increase in the same index compared with G2. However, a significant increase in the average of egg mass produced per hen compared with those of G1.

Key words: Egg laying hens, intermittent lighting, productive performance

INTRODUCTION

Lighting is the most factor that greatly affects the performance of the production and reproduction of birds, sexual maturation, feeding behavior and productivity of eggs and egg weight (Dawson *et al*., 2001; Lardner *et al*., 2012; Lewis *et al*., 2010; Lewis and Gous, 2006; Morris, 1998).

Eitan and Soller (1991) found that the lighting systems may be designed either to induce early or late sexual maturity, which affects significantly egg weight. Lesson and Summer (1980) studied the impact of the timing of incitement photosynthesis, which leads to the production of the largest mass egg.

As for the period of light that should be given to the birds during the production cycle, it was previously believed that the 14 h light per day is the limit which guarantees to get the highest productivity of the eggs from the pullets but the lighting system must be differentiated during the production cycle and increasing the period of daily light during the production cycle helps to raise the productivity of eggs compared with the use of a daily-constant light (Marr *et al*., 1962). Etches (1996) found that it is important to know how many hours of daily lights must be given to the birds in the period before and after sexual maturity to increase egg production to the maximum.

Several researches were conducted to prepare intermittent lighting systems applied to egg laying hens during the production stage. Durmus and Kalebasi (2009) showed that lighting intermittent system of egg layer can be used for the profitability of egg production and better feed conversion ratio. Lewis *et al*. (1992) concluded that it is possible for intermittent lighting to reduce the mortality rate of egg laying hen and this has been confirmed in similar studies conducted (Freitas *et al*., 2010; Gewehr and de Freitas, 2007).

Shen *et al*. (2012) confirmed that the intermittent lighting system (8L: 4D: 4L: 8D) of egg laying hens during the production stage compared with the traditional lighting system of (16L: 8D) led to an improvement in the rate of egg-laying, egg weight and a decrease in feed conversion ratio. Rahimi *et al*. (2005) and Classen *et al*. (2004) observed that intermittent lighting in the production stage can shorten the duration of lighting and reduce feed consumption as it works to increase productivity.

He Ma *et al*. (2013) concluded that the intermittent lighting system (13L: 5D: 1L: 5D) compared with the traditional lighting system of (16L: 8D) to egg laying hen during the production stage led to an improvement in the egg-laying rate, reduction of feed consumption and the mortality rate.

Research is still in progress regarding the effect of intermittent lighting on the performance of egg laying, since new hybrids of egg laying with high efficiency and

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hereditary are produced. Thus, the objectives of this research were to study the effect of applying traditional lighting systems during the growth and production stags in some of the of productive performance of egg laying hens and the effect of applying intermittent lighting system during the period of growth and during the production phase in some of the productive performance of egg laying hens.

MATERIALS AND METHODS

This research was carried out in krabo modern poultry house, Agriculture College, Damascus University during 2011-2012. A total of 1512 one-day-old chicks of Babcock B-300-hybrid layer hens distributed randomly and equally into six groups (252 chicks/group) with 3 replicates (84 chicks/replicate) in the same group were housed until the age of 17 weeks (stage 1) in a closed house with deep litter and then transferred to the production closed house equipped with batteries of a three-tries until the age of 60 weeks (stage 2). At the eighteenth week of age, birds of replicates in groups 1, 2 and 3 were transferred to first production house and those of groups 4, 5 and 6 were transferred to the second production house of the model CSS with an average of five birds in each cage, (50 x 45 cm^2). All birds were undertaken similar nutritional and health conditions but were exposed for the following different lighting systems.

First group (control 1, G1): Birds were exposed to step down-step up (step down through the stage of growth and step up at and through the production stage). Birds in the second group (control 2, G2) were exposed to short constant and step up lighting systems during stages 1 and 2, respectively. While birds in G3, G4, G5 and G6 were exposed to intermittent lighting-step up; step down-intermittent; short constant-intermittent and intermittent-intermittent lighting systems during stages 1 and 2, respectively (Table 1 and 2).

Productivity indicators studied from 19 until 60 weeks of age were assigned to include: the live body weight average at age 60 weeks, the average of sexual maturity age (age of birds in days when the rate of daily laying eggs arrive to 50%), average production of hen eggs (HD), egg weight average and egg mass average per hen and mortality rate (21-60 weeks).

Mortality percentages of the groups were analyzed by Fisher test (F) and A simple randomized block design with three replicates was applied and analysis of variance was applied to study the effect of lighting system. The averages of other studied indicators were compared using LSD.

RESULTS AND DISCUSSION

Mortality rate: Results showed (Table 3) that the there was no significant difference ($p<0.05$) with mortality rate among different groups, this means that the applied intermittent lighting system to birds did not have any effect on mortality through the production stage, this does not correspond with the findings of He Ma *et al.* (2013) and Shen *et al.* (2012) but it is in agreement with Morris and Butler (1995) who pointed out that the application of intermittent lighting on laying hen during the production stage has no effect on the mortality rate. It was also found that the lighting system applied during the growth phase did not affect significantly on mortality rate during the production stage among groups. Overall mortality rate per month during the production stage was accepted and within allowable limits (1%).

Live body weight: No significant differences ($p<0.05$) were observed among the different groups with the average of live body weight of birds at age of 60 weeks, this indicated that the application of the intermittent lighting system compared with a conventional lighting did not have considerable effects in the average of live body weight of birds during the production stage. This is in consistent with the results of Banks and Koen (1989). Simultaneously, applying lighting system to the birds during the growth phase did not have significant effect in the average of live body weight of the bird during the production stage.

Sexual maturity (SM): Statistical analysis (Table 3) indicated that every two groups identical with applied lighting system during the growth stage had no significant difference related to SM. and at the same time it was noted that the lighting system is applied to the birds during the growth phase has a clear and significant effect on SM since the application of short constant lighting system on birds (G2 and G5) during the growth phase led to significant early (10 days) in SM ($p<0.01$) in comparison with step down lighting system. (G1 and G4) and this is consistent with Lesson *et al.* (2005) and Lewis and Morris (2005). It was also observed (Table 3) that the application of the intermittent lighting system on birds during the growth phase in G3 and G6 led to a significant earlier sexual maturity ($p<0.05$) by 5.3-7 days in comparison with the step down lighting system (G1 and G4). This sexual maturity was convergent in the birds of groups (G2 vs. G3). However, this difference was significant ($p<0.05$) between G5 vs. G6.

Egg productivity

Egg production (HD): It was fond that the application of the constant short lighting system during the growth phase (G2 and G5) led to improve significantly ($p<0.05$) in the HD in comparison with step down lighting system (G1 and G4). The application of the intermittent lighting system during the growth phase (G3) resulted to a

Table 1: Lighting system applied in different groups (the number of hours daily lighting in different groups (h-min)

	Groups					
Birds age (wk)	Control 1 (G1)	Control 2 (G2)	G3	G4	G5	G6
1	(1) 23-30	(1) 23-30	(2) 18-00	(1) 23-30	(1) 23-30	(2) 18-00
2	(1) 17-00	(1) 15-00	(2) 16-00	(1) 17-00	(1) 15-00	(2) 16-00
3	(1) 16-30	(1) 9-00	(2) 14-00	(1) 16-30	(1) 9-00	(2) 14-00
4	(1) 16-00	(1) 9-00	(2) 12-00	(1) 16-00	(1) 9-00	(2) 12-00
5	(1) 15-30	(1) 9-00	(2) 10-00	(1) 15-30	(1) 9-00	(2) 10-00
6	(1) 15-00	(1) 9-00	(2) 8-00	(1) 15-00	(1) 9-00	(2) 8-00
7	(1) 14-30	(1) 9-00	(2) 8-00	(1) 14-30	(1) 9-00	(2) 8-00
8	(1) 14-00	(1) 9-00	(2) 8-00	(1) 14-00	(1) 9-00	(2) 8-00
9	(1) 13-30	(1) 9-00	(2) 8-00	(1) 13-30	(1) 9-00	(2) 8-00
10	(1) 13-00	(1) 9-00	(2) 8-00	(1) 13-00	(1) 9-00	(2) 8-00
11	(1) 12-30	(1) 9-00	(2) 8-00	(1) 12-30	(1) 9-00	(2) 8-00
12	(1) 12-00	(1) 9-00	(2) 8-00	(1) 12-00	(1) 9-00	(2) 8-00
13	(1) 11-30	(1) 9-00	(2) 8-00	(1) 11-30	(1) 9-00	(2) 8-00
14	(1) 11-00	(1) 9-00	(2) 8-00	(1) 11-00	(1) 9-00	(2) 8-00
15	(1) 10-30	(1) 9-00	(2) 8-00	(1) 10-30	(1) 9-00	(2) 8-00
16	(1) 10-00	(1) 9-00	(2) 8-00	(1) 10-00	(1) 9-00	(2) 8-00
17	(1) 9-30	(1) 9-00	(2) 8-00	(1) 9-30	(1) 9-00	(2) 8-00
18	(1) 9-00	(1) 9-00	(1) 9-00	(2) 9-00	(2) 9-00	(2) 9-00
19	(1) 10-00	(1) 10-00	(1) 10-00	(2) 9-30	(2) 9-30	(2) 9-30
20	(1) 10-30	(1) 10-30	(1) 10-30	(2) 10-00	(2) 10-00	(2) 10-00
21	(1) 11-00	(1) 11-00	(1) 11-00	(2) 10-30	(2) 10-30	(2) 10-30
22	(1) 11-30	(1) 11-30	(1) 11-30	(2) 11-00	(2) 11-00	(2) 11-00
23	(1) 12-00	(1) 12-00	(1) 12-00	(2) 11-30	(2) 11-30	(2) 11-30
24	(1) 12-30	(1) 12-30	(1) 12-30	(2) 12-00	(2) 12-00	(2) 12-00
25	(1) 13-00	(1) 13-00	(1) 13-00	(2) 12-00	(2) 12-00	(2) 12-00
26	(1) 13-30	(1) 13-30	(1) 13-30	(2) 12-00	(2) 12-00	(2) 12-00
27	(1) 14-00	(1) 14-00	(1) 14-00	(2) 12-00	(2) 12-00	(2) 12-00
28	(1) 14-30	(1) 14-30	(1) 14-30	(2) 12-00	(2) 12-00	(2) 12-00
29	(1) 15-00	(1) 15-00	(1) 15-00	(2) 12-00	(2) 12-00	(2) 12-00
30	(1) 15-30	(1) 15-30	(1) 15-30	(2) 12-00	(2) 12-00	(2) 12-00
31-33	(1) 16-00	(1) 16-00	(1) 16-00	(2) 12-00	(2) 12-00	(2) 12-00
34	(1) 16-30	(1) 16-30	(1) 16-30	(2) 12-30	(2) 12-30	(2) 12-30
35-60	(1) 17-00	(1) 17-00	(1) 17-00	(2) 13-00	(2) 13-00	(2) 13-00

[(1) continuous lighting (2) intermittent lighting are as shown in Table 2]

Table 2: Intermittent lighting

Birds age (week)	No. of h daily lighting (h-min)	Intermittent lighting system	Connecting-time of electrical (H:M)	Disconnecting time of electrical (H:M)	Connecting-time of electrical (H:M)	Disconnecting time of electrical (H:M)
1	18	9L: 4D: 9L: 2D	8	17	21	6
2	16	8L: 6D: 8L: 2D	8	16	22	6
3	14	8L: 8D: 6L: 2D	8	16	24	6
4	12	8L: 10D: 4L: 2D	8	16	2	6
5	10	8L: 11D: 2L: 3D	8	16	3	5
6-17	8	7L: 12D: 1L: 4D	8	15	3	4
18	9	7L: 14-30D: 2L: 0-30D	8	15	5-30	7-30
19	9-30	7-30L: 13-30D: 2L: 1D	8	15-30	5	7
20	10	8L: 12-30D: 2L: 1-30D	8	16	4-30	6-30
21	10-30	8-30L: 11-30D: 2L: 2D	8	16-30	4	6
22	11	9L: 10-30D: 2L: 2-30D	8	17	3-30	5-30
23	11-30	9-30L: 9-30D: 2L: 3D	8	17-30	3	5
24	12	10L: 8-30D: 2L: 3-30D	8	18	2-30	4-30
25-33	12	10L: 8D: 2L: 4D	8	18	2	4
34	12-30	10-30L: 7-30D: 2L: 4D	8	18-30	2	4
35-60	13	11L: 7D: 2L: 4D	8	19-00	2	4

Table 3: Mortality rate (MR) and averages of live body weight (LBW) and sexual maturity (SM)

	Groups						----- L.S.D -----	
Indicator studied	G1	G2	G3	G4	G5	G6	5%	1%
MR during production stage	9.3^{a}	10.6^{a}	11.1^{a}	12.6^{a}	12.0^{a}	10.3^{a}	-	-
LBW at 60 weeks of age (g)	1785^{a}	1738^{a}	1815^{a}	1773^{a}	1705^{a}	1810^{a}	-	-
SM (days)	151.0^{a}	141.0^{bc}	144.0^{b}	149.0^{a}	139.3^{c}	143.7^{b}	4.2	5.8

significant reduce ($p<0.05$) in HD in the comparison with the constant short lighting system under the step-up lighting system (G2 and G3) during the production stage, while it did not lead to significant reduction in HD under the intermittent lighting conditions during the production stage (G5 and G6). The application of the intermittent

Table 4: Egg productivity in birds of different groups exposed to different lighting systems

	Groups						L.S.D	
Index	G1	G2	G3	G4	G5	G6	5%	1%
HD	240.0^{a}	254.6^{b}	245.6^{ac}	246.2^{ac}	256.0^{b}	248.7^{bc}	8.1	11.3
EW (g)	61.2^{a}	60.2^{c}	61.1^{ad}	61.3^{a}	60.7^{b}	60.8^{bd}	0.4	0.5
EM (kg)	14.694^{a}	15.326^{bc}	15.008^{ab}	15.101^{abc}	15.527^{c}	15.112^{abc}	0.491	-

HD: Hen day, EW: Average of egg weight, EM: Egg mass per hen

lighting system (G4, G5 and G6) did not improve considerably in HD in comparison with the step up lighting system (G1, G2 and G3) during the production stage and this is consistent with Shen *et al.* (2012) and He Ma *et al.* (2013).

Egg weight: It was observed (Table 4) that short constant lighting system during the growth period (G2) led to a significant decrease ($p<0.01$) with an egg weight average in comparison with the step down and intermittent lighting systems (G1 and G3) applied during the growth phase. Results also indicated that application of short constant lighting system and intermittent system (G5 and G6) during the period of growth caused to a significant decrease ($p<0.01$) with the egg weight average in comparison with the step down lighting system (G4) applied during the growing period. It was also found that the intermittent lighting system (G5) resulted to a significant improvement ($p<0.01$) in the average of egg compared with the step up lighting system (G2) during the production phase. As a result, it can be said that the lighting system during the growth period has an impact with an egg weight average for the entire production stage, where the step down system was the best, followed by intermittent lighting system and finally short constant lighting system.

Moreover, the application of intermittent lighting system (G5) compared with step up lighting system (G2) during the production period caused a significant improvement of the egg weight average for the entire stage production and this is consistent with the findings of Shen *et al.* (2012) and Lewis and Gous (2006).

Egg mass produced/hen: Results (Table 4) indicated that the short constant lighting system applied during the growth period (G2) led to significant improvement ($p<0.05$) of egg mass (EM) produced per hen compared with the step down lighting system (G1) while it was found that the intermittent lighting system applied during the period of growth (G3) did not affect significantly on EM in comparison with short constant and step down lighting systems applied during the growth phase.

Results also indicated (Table 4) that the intermittent lighting system applied during the production phase had improved, but not significantly the egg mass produced per hen during the production stage, compared with a step up lighting system and this corresponds with the findings of both Morris *et al.* (1988), Lewis and Gous (2006).

Conclusions and suggestions: It was concluded that the application of the of short-constant lighting system on the birds during the growth stage and intermittent lighting system during the production stage (G5) was the best favorable to help in a significant earlier sexual maturity by 11.7 days, caused a significant improvement in HD and a significant increase in the average of egg mass. Thus it is suggested to be applied since helps to get the highest productivity of laying hens and savings in electrical energy required for lighting barns.

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