THE EFFECT OF PHOTOPERIOD, LIGHT INTENSITY AND WATTAGE POWER ON PERFORMANCE OF DANDARAWI CHICKEN

El-Sheikh, T.M., A.M. El-Gammal, M.N. Makled

[1]Faculty of Agriculture, Sohag University, Indonesia
[2]Faculty of Agriculture, Assiut University, Indonesia
e-mail: talatm2@yahoo.com

Abstract

A total number of 840 birds were used to study the effect of photoperiod, light intensity and wattage power on performance and blood constituents of Dandarawi fowl. The birds were classified into seven groups, 2 for the light intensity, 2 for photoperiod, 2 for wattage power and 1 was used as a control. The traits studied were sexual maturity, egg production and blood constituents. Light intensity of 80 luxes during growing period reduced body weight at sexual maturity than that obtained by using 20 and 5 luxes, respectively. The same trend was observed with first egg weight. The high intensity during rearing period delayed the sexual maturity, since group held at 20 luxes had the youngest age, while the group held at 80 luxes had the oldest age. The age at sexual maturity decreased as the photoperiod during growing period increased. The egg weight at sexual maturity increased as the photoperiod decreased. Body weight and age at sexual maturity decreased as the wattage power increased. The hen housed production and survivor egg laying rate decreased as light intensity increased. The performance was better under low light intensity of 15 luxes. The groups which illuminated to 16 hours produced egg production more than that illuminated to 18 and 20 hours. Hen housed production and survivor egg production for the groups exposed to 18 and 20 hours was less than that of the control. The hen housed production and survivor production were decreased as wattage power increase.

Key words: Dandarawi fowl, photoperiod, light intensity and wattage power, egg production

INTRODUCTION

Photoperiod: Classen and Riddell (1989) suggested that birds exposed to increasing photoperiod appeared to be more active. Siegel *et al*. (1963a) reported that performance was better in young White Leghorns housed under a short six hours day length than in birds exposed to a 14 hours daylength, even though chicks housed on 6L:18D did not eat more feed than chicks housed on 14L:10D; however, they used it more efficiently (Siegel *et al*., 1963b).

As for the effect of light on egg production, it was reported by many workers that light regulates the timing of oviposition in the fowl (Morris, 1978; Bahatti and Morris, 1977).

Morris (1966a) found that the relationship between photoperiod and sexual maturity was curvilinear, with the earliest maturity occuring in flocks with 10,12 and 14 hours of light. However, as the birds approaches sexual maturity, the response to light tends to increase. The same trend was obtained by King (1961).

Decreasing photoperiod during growing stage resulted in egg production increments (King, 1962). Meanwhile, egg production in White Leghorn decreased slightly by exposing the birds to 16 hours as compared with 14 hours of artificial light daily from hatch to 20 weeks of age, (Lowe and Heywang, 1961). Morris (1979) reported that 10L:14D is sufficient for maximum egg production, but 8L:16D is not.

Light intensity: Morris (1966b) showed that pullets reared under very dim lights and transfered to laying house with the same dim lighting were 12 days later maturing than birds reared under more normal lighting of 5 lux. Morris (1966b) found that the maximum egg production was at 25 lux. Baughman and

Brake (1987) reported that exposure to low light intensities during the growing period would improve breeder performance in the laying house.

MATERIAL AND METHOD

A total number of 840 birds were used in this experiment. The birds were classified into seven groups, (120 birds each): two for the light intensity treatments; two for photoperiod treatments, two for wattage power, and one was used as a general control.

1- Birds were exposed to 80 luxes for 8 hours light during the growing period and then 240 luxes for 16 hours light during the laying period. **2-** Birds were kept at 20 luxes for 8 hours light during the growing period and then to 60 luxes for 16 hours during the laying period. 3- Birds were exposed to 16 hours light (with intensity of 5 luxes during the growing period) then to 20 hours light (with intensity of 15 luxes during the laying period). **4-** Birds were exposed to 12 hours light (with intensity of 5 luxes during the growing period) then to 18 hours (with 15 luxes during). 5- Birds were kept at 200 watt incandescent bulb for 8 hours light during the growing period, then 16 for hours light during the laying period with the same wattage power. **6-** Birds were kept at 100 watt incandescent bulb for 8 hours light and 16 hours light during the growing and laying period, respectively. **7-** Birds were kept at 40 watt incandescent bulb throughout the experimental period with 8 hours photoperiod and 5 luxes intensity during the growing period and 16 hours with 15 luxes intensity during laying periods. The lighting programs are summarized in Table (1).

RESULTS AND DISCUSSIONS

Effect of light intensity : The effect of light intensity on sexual maturity traits are presented in Table (2). Using high light intensity (80 luxes) during the growing period reduces body weight at sexual maturity by about 6.1 and 12.5 grams than that obtained by using 20 and 5 luxes, respectively. The same trend was observed with first egg weight, which decreases by about 1.1 and 2.2 grams by using 80 luxes as compared with those obtained by using 5 and 20 luxes, respectively. The reduction in both body weight and egg weight at sexual maturity indicated that the high light intensity may act as stress factor during the growing period.

With respect to the effect of light intensity on age at sexual maturity, Table (2) shows that the group held at 20 luxes reached sexual maturity at the youngest age, while the group held at 80 luxes reached it the oldest age . The control group (5 luxes) reached it at an intermediate age. In other words, the high intensity during rearing period delays the sexual maturity.

Thus, it could be concluded that the use of 5 or 20 luxes during rearing period is the best for sexual maturity traits. While the use of 80 luxes had an adverse effect on age, body weight and egg weight at sexual maturity. Morris (1967a) concluded that the light intensity level during growing period is unimportant, since pullets could be reared successfully with either very high or very low intensities. The failure to obtain a pronounced effect by Morris maybe due to the low intensity levels used by him (0.2 to 5 luxes). Deaton *et al*. (1976) and Proudfoot and Sefton (1978) suggested that performance is better under low light intensity because the chicks are less active and therefore lose less energy in exercise.

Effect of photoperiod : As shown from Table (2), the pullets subjected to 5, 10, and 15 hours of light reached sexual maturity at the age of 172.1, 165.1, and 160.4 days, respectively. This indicates that the age of sexual maturity decreases as the photoperiod during growing period increases. These result are in agreement with the findings of Bowman *et al*. (1966) who reported that restriction of daily light period to 6 hours during the growing stage retarded age at sexual maturity.

With respect to the effect of photoperiod on first egg weight, Table (2) shows that egg weight at sexual maturity increases as the photoperiod during growing period decreases. It was 32.9, 31.9, and 30.9 grams for the groups exposed to 5, 10, and 15 hours. Kamar *et al*. (1973) found that the early-

maturity hens had more developed ovaries and oviducts than the late maturing ones.

Effect of wattage power: Data presented in Table (2) show that, body weight at sexual maturity decreases as the wattage power increases. The body weight of the groups held at the same light intensity and photoperiod but reared under a lamp power of 40, 100 and 200 watts was 1182.5, 1154.3 and 1091.9 grams at sexual maturity, respectively. This maybe due to the stressful effect caused by using 200 watt lamp power. This result is in accordance with the finding of Deaton *et al*. (1989) who reported that 25 watt bulbs will provide enough light at night for maximum growth of male broiler chicks in a curtain-sided house compared with that provided by 75 to 100 watt incandescent lamps.

Age at sexual maturity for the group held at 40, 100 and 200 watt was 172.1, 166.0 and 176.3 days, respectively. The corresponding values for egg weight are 32.9, 33.6 and 31.5 grams, respectively (Table 2).

It is interesting to note that the group exposed to light provided by 200 watt lamps reached sexual maturity was decreased by about 4.2 days later and egg weight and body weight at sexual maturity by about 1.4 and 90.6 grams, respectively, compared with the control (40 watt). Duncan multiple test shows that differences in body weight, egg weight and age at sexual maturity due wattage power treatments were significant (Table 2). Analysis of variance for the effect of wattage power on body weight, egg weight and age at sexual maturity were highly significant (Table 2).

2- Egg production

Effect of light intensity: The data of egg production as affected by light treatments are presented in Table (3), it can be observed that the hen housed production decreases as light intensity increases, the decrease is about 2.9% and 7.3% by using intensity of 60 and 240 luxes as compared with the control (15 luxes). This finding is in agreement with that reported by Morris (1967c) who reported that 10 luxes was adequate light intensity for maximum egg production, Morris (1967b) concluded that for maximum yield in cage operations, light intensity should be not less than 5 luxes.

Survivor mass production as affected by light intensity is presented in Table (3). The survivor egg laying rate decreased by about 1.6 and 4.6% by using 60 and 240 lux as compared with 15 luxes, respectively. The reduction in survivor egg laying rate as a result of increase in light intensity was less than hen housed egg production. This maybe attributed to the increase in mortality rate with increasing light intensity. This finding is in agreement with that reported by Newberry *et al*. (1985) who observed higher chicken activity under 6 to 12 luxes as compared with 0.5 lux areas within pens. Newberry *et al*. (1988) observed that behavior was affected by light intensity.

Analysis of variance (Table 3) shows that the effect of light intensity on egg production was highly significant.

Effect of photoperiod: The hen housed and survivor egg production are presented in Table (3). It can be noticed that the hen housed egg production for the groups exposed to 18 and 20 hours less than the control (16 hours) by about 1.6 and 7.3 % , respectively. The corresponding values for survivor egg production were 1.7 and 4.5%, respectively. The effect of 18 hours photoperiod is not significant, while that of 20 hours is significant as compared with the control. This result is in accordance with that of El-sheikh (1989) who stated that 16 hours light maybe adequate for Dandarawi and Fayomi hens for egg production as compared with 14 and 18 hours photoperiod. The reduction in egg production by using continuous 18 hours photoperiod maybe due to the stressful effect of long period light. Continuous light has been shown to be stressful to growing broilers (Buckland, 1975; Buckland *et al*., 1976; Freeman *et al*., 1981). Buckland *et al*. (1976) reported that plasma corticoids were higher in broilers grown under continuous light as compared with intermittent lighting programs. Freeman *et al*. (1981) reported that the chicks given continuous light were considered stressed because of adrenal hypertrophy and elevated plasma free fatty acids concentrations. Also,

it was reported by many workers that plasma concentration increased during the light period and decreased during the darkness, while T4 showed an opposite responses (Newcomer, 1974; Klanorf *et al*., 1978; Kuhn *et al*., 1982). Thyroid hormones have been used as indicators of stress response (Wodzicka-Tomaszewska *et al*., 1982). Reduction of plasma thyroid hormone concentrations during stress is related to plasma corticostorone (Williamson and Davison, 1987; Decuypere and Kuhn,1988; Klandorf *et al*., 1988). Sharp (1993) mentioned that the minimum and maximum day lengths required to stimulate reproductive function in short day hens, calculated from the photoperiodic response curves for luteinizing hormone release are about 10 and 13 hours, respectively, depending on genotype.

In the present study, increasing photoperiod to 20 hours reduced significantly egg production than 16 hours light. Sharp *et al*. (1992) showed that the prolonged exposure to long days was associated with a decrease in egg laying, pituitary LH content, pituitary responsiveness to gonadotropin-releasing hormone (GnRH) and concentration of plasma LH. These changes in reproductive function maybe due to a combination of development of a long day-induced inhibitory input to GnrRH neurons and age per se (Dunn and Sharp, 1992). Sleep deprivation associated with continuous or near continuous daylights may increase physiological stress (Wiepkema, 1981).

Although continuous and near continuous daylights have been associated with the increase in physiological stress, it was interesting to note (Savory and Duncan, 1982) that both broiler and layer strains preferred to be illuminated for between 20% and 99% of their time. Neither broiler nor layer strains were prepared to work for a longer dark period. The results of the present study show that the groups which illuminated to 66% of their time produced egg production more than which were illuminated 75 and 83.3% of their time .

Effect of wattage power : As listed in Table (3) the hen housed production is 69.4, 67 and 59.8%, while the survivor production is 72, 71.9, and 65.2% for the hens received illumination by a lamp power of 40, 100 and 200 watts, respectively. Differences between means of the groups exposed to 200 watts and the two other groups are significant. The reduction in egg production in group which lighted with 200 watt lamps, maybe due to the differences in nature of rays, since all treatments were exposed to the same intensity and photoperiod. These results are in harmony with findings of Andrews and Zimmermann (1990) who found that body gain was less by using 100 watts compared with 25 watt.

Table (1) The lighting programs during the experimental period

Treatments	Growing period			laying period		
	period (hours)	intensity (luxes)	power (watt)	period (hours)	intensity (luxes)	power (watt)
Photoperiod	16	5	40	20	15	40
	12	5	40	18	15	40
Intensity	8	80	40	15	240	40
	8	20	40	15	60	40
Wattage power	8	5	200	16	15	200
	8	5	100	16	15	100
Control	8	5	40	16	15	40

Table (2) Effect of light treatments on sexual maturity traits.

Light treatment	Body weight at S.M (g)	Egg weight at S.M (g)	Age at S.M* (days)
Light intensity :			
80 luxes	1170.5^{a}	31.8^{b}	174.6^{a}
20 luxes	1176.6^{a}	34.0^{a}	165.1^{b}
5 luxes	1182.5^{a}	32.9^{b}	172.1^{a}
	NS	***	***
Photoperiod			
15 hours	1133.7^{b}	30.9^{b}	160.1^{b}
10 hours	1176.3^{a}	31.9^{b}	165.1^{b}
5 hours	1182.5^{a}	32.9^{a}	172.1^{a}
	***	***	***
Wattage power			
200 watt	1091.9^{b}	31.5^{c}	176.3^{a}
100 watt	1154.3^{b}	33.6^{a}	166.0^{b}
40 watt	1182.5^{a}	32.9^{b}	172.1^{a}
	***	*	**

* Significant at .05 ** Significant at 0.01 *** Significant at 0.0001
+ S.M. = Sexual maturity
Means within the column within the character with same superscript are not significantly different (P< 0.05)

Table (3) Effect of light treatments on egg production during the experimental period (90 days).

Light treatments	Hen housed production		Survivor production	
	Mass (g)	%	Mass (g)	%
Light intensity :				
240 luxes	2396^{c}	62.1^{b}	2601^{c}	67.4^{b}
60 luxes	2604^{b}	66.5^{b}	2758^{b}	70.4^{b}
15 luxes	2804^{a}	69.4^{a}	2911^{a}	72.0^{a}
Probability	***	***	***	***
Photoperiod				
20 hours	2527^{b}	62.1^{b}	2746^{b}	67.5^{b}
18 hours	2705^{ab}	67.8^{b}	2841^{ab}	70.3^{b}
16 hours	2804^{a}	69.4^{a}	2911^{a}	72.0^{a}
Probability	***	***	***	***
Wattage power				
200 watt	2271^{b}	59.8^{c}	2475^{b}	65.2^{b}
100 watt	2654^{a}	67.0^{c}	2884^{a}	71.9^{a}
40 watt	2804^{a}	69.4^{a}	2911^{a}	72.0^{a}
Probability	***	***	***	***

Means within the column within the character with same superscript are not significantly different (P< 0.05)

CONCLUSIONS

It could be concluded that the use of 5 or 20 luxes during rearing period is the best for sexual maturity traits. While the use of 80 luxes had an adverse effect on age, body weight and egg weight at sexual maturity. Performance is better under low light intensity (15 luxes). In addition the low light intensity reduced the consumption in electricity required for lighting.

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