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LIGHT REQUIREMENTS OF THE LAYING HEN UNDER INTERMITTENT LIGHTING SYSTEM

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ABSTRACT

A series of three short term trials were carried out to quantify light requirements, by defining both the duration and frequency of light pulses, necessary for maximum egg production. The investigations were confined to an 8 hours (h) period, while the remaining 16 h were equally divided into 8 h continuous light and 8 h dark period. It was found that eight 1-minute pulses spaced at hourly intervals supplied before or after an 8 h photoperiod induced maximum stimulation in laying hens. Reducing the duration of 1-minute pulse to 10seconds or reducing the frequency to one every two hours gave a significantly lower rate of lay.

INTRODUCTION

It is now well established that photoperiodic responses in plants and animals can be induced by systems of intermittent lighting. The concept of lighting birds intermittently is based on the observation that equally good production can be obtained by lighting a small fraction of an hour to the full 60 minutes.

Many aspects of illumination of the fowl have been studied including duration of the photoperiod (Morris 1967b), intensity of light (Morris and Owen, 1966 and Morris. 1967a), interrupted lighting (Van Tienhoven and Ostrander, 1976) and the use of ahemeral cycles (Morris, 1973 & 1979). Although there seems to be no lighting pattern which will improve egg output as compared to that which results from the commonly used 14 h photoperiod, however, past studies on skeleton photoperiods indicated that intermittent lighting was able to sustain rates of lay equivalent to that of a variety of conventional lighting programmes (Cooper and Barnett, 1974, 1977; King, 1980).

In recent years search for more efficient lighting systems for egg production is being made because of the fall in profit margins and the rise in cost of electricity and feed. The use of intermittent lighting offers the certainty of saving electricity and the possibility of improving feed efficiency which stresses the need for further work on this aspect of management of laying hens. This study was, therefore, undertaken to quantify the rates for successful intermittent lighting in the hen.

MATERIALS AND METHODS

The experiment was conducted using such facilities as described by Bhatti and Morris (1977). Six hundred day-old chicks of Ross Tint breed were brooded and reared in a windowless house. They were exposed to 24 hours (h) bright light for the first day, followed by 8L (light) : 16D (dark) from the second day till 17 weeks of age. The light intensity in the growing stage was about 1 lux under the lamp and 0.5 lux towards the corners of the rearing house. At 17 weeks of age, 480 pullets were transferred to a light-proof laying house where the reported series of trials were conducted. The investigations were confined to an 8 h period while the remaining 16h were equally divided into 8h continuous light and 8 h dark period so that all light regimes availed a 16h effective photoperiod.

Various measurements were taken from different trials but the principal variable, which formed the basis of conclusions, was rate of lay. The other measurements recorded from time to time in different experiments were sexual maturity, egg weight, feed intake and body weight.

Experiment I

At 17 weeks of age, the pullets were transferred to 20 of the 24 rooms of the laying house. The birds were subjected to five light treatments (Table 1) and each treatment was assigned to four rooms at random. Treatment 1 (8L:16D) and 5(16L : 8D) served as negative and positive controls respectively. Test treatments 2,3 and 4 were supplied with a base photoperiod of 8h which was followed by eight light pulses spaced at hourly intervals; the flashes lasting for 10 second (s) 1 minute (m) or 10m, respectively. In all treatments, the main photoperiod began at 08.00 daily. Responses to treatments were measured in terms of sexual maturity, rate of lay, egg weight, feed intake and body weight.

RESULTS

Sexual maturity: The effect of intermittent lighting treatments along with short- and long-day controls on age at first egg is shown in Table 1. A spread of 6 days in maturity was obtained among the means of five treatments. The addition of eight 10s pulses to an 8h photoperiod, advanced maturity by two days and this advance in maturity was progressive; further increases in the duration of the pulse hastened maturity and with 10m pulse, birds matured at the same age as the long-day control birds.

Rate of lay : The birds given 1m and 10 m pulses of light and 16 h continuous light gave similar rates of lay which were significantly better than those of the 10s and the short-day control birds (Table 1). There was no significant difference in rates of lay between 10s birds and the short-day control birds.

Body weight : Mean body weights are given in Table 1. The groups of birds which were either maintained on 8L : 16D (as during rearing) or supplied with 10s pulses at housing gained significantly ($P<0.01$) more weight than the birds held on the other light treatments till 29 weeks of age. There were no substantial differences in mean body weights between 10s and 8L : 16D birds or among 1m, 10m and long-day control birds.

Egg weight : The groups of birds supplied with 10s or 8L : 16D at housing (with higher body weights than the other 3 groups of birds) produced heavier eggs than the other three treatments. There were no differences in egg weights among 1m or 10 m and the long-day control birds (Table 1).

Feed consumption : The average daily feed consumption is given in Table 1. Feed consumption values did not show significant differences among the five treatments. The long-day control birds did consume more feed than the other comparable groups of birds. The birds held on intermittent lighting ate a substantial amount of feed even during the dark periods.

DISCUSSION

With increase in duration of pulses, a progressive reductoin in age at first egg production was noticed. When the duration of the pulse reached 1m, the difference from the long-day control was no longer significant and the birds matured normally. The increased response with 1m and 10 m pulses might be due ot the increased duration of the pulse. Therefore, the transfer of the birds from 8L to 16L or the addition of eight 1m or 10m pulses to an 8h photoperiod at housing (at 17 weeks of age) provided an extra 8 h stimulation to birds which resulted in substantial advance in maturity.

Table 1. *The effect of duration of the light pulse on the performance of Ross Tint pullets (each treatment consisted of 4 lots of 24 birds)*

Treatment No.	Treatment	Mean age at first egg (days)	Eggs/100 bird days (26-29 weeks of age)	Mean egg weight 26-29 weeks of age (g)	Feed g/bird day (27 weeks age)	Mean body weight at 29 weeks of age(g)
1.	8L:16D	152	91.0	55.2	107	1937
2.	8L:8x10s pulses at 60m intervals:8D	150	92.3	55.2	107	1944
3.	8L:8x1m pulses at 59m intervals:8D	148	97.0	54.7	107	1864
4.	8L:8x10m pulses at 50m intervals:8D	146	95.5	53.8	108	1832
5.	16L:8D	146	96.5	53.7	111	1854
	S.E. of each mean :	0.67	0.05	0.36	1.98	20.67

Ten-second pulses were found insufficient in producing the normal response, while 1m pulses gave rate of lay equal to the long-day control and no advantage was observed from increasing the duration of the pulse beyond one minute. The results are in agreement with Morris and Mian (1980) who used 1m, 5m, and 15m pulses in their study.

The birds kept on short-day and 10s pulses of light were heavier because they matured late and they put on more weight than the early maturing ones before they started laying.

The short-day reared birds were transferred to various light treatments at housing and they reached maturity at different ages although the differences were small. Egg weight data collected 10 weeks after housing showed that the late maturing birds were heavier and laid heavier eggs which seemed consistent with the general notion that late maturing birds laid heavier eggs.

The birds on intermittent lighting schedules consumed on average 4g/bird less feed than the long-day control birds. This slightly higher feed intake of the long-day control birds could be due to extended activity of the birds because of the longer light period than the intermittent light treatments. As a result the birds' maintenance requirements increased due to this protracted span of activity and hence consumed more feed.

As the 1m pulse proved photoperiodically effective, it was selected for further investigations in the following two trials. It was then decided to explore the effect of different phasing of 1m pulses (Experiment 2) and then quantify the minimum frequency of 1m pulse needed for a normal reproductive response (experiment 3).

Experiment 2

After the termination of experiment 1, the pens of birds on the negative control continued to serve as short-day control again. The pens on treatments 2,3,4 and 5 in experiment 1, were randomly reallocated to new treatments (2,3,4, and 5) in such a way that one pen from each old treatment was assigned to each new treatment i.e., the four old treatments served as four blocks. The schedules of treatments with their phasing time are given in Table 2.

Responses to these treatments were determined in terms of rate of lay, egg weight and feed consumption. Rate of lay and egg weight were calculated as in

Table 2. *The effect of different phasing of intermittent lighting on the performance of Ross Tint pullets (each treatment consisted of 4 lots of 24 birds)*

Treatment No.	Treatment	Egg/100 bird days (31-34 weeks age)	Mean egg weight (g) (31-34 weeks age)	Feed:g/bird day (31-34 weeks age)
1.	8L:16D	90.1	58.9	115
2.	*8L:8x1m pulses at 60m intervals:8D	94 4	57.0	110
3.	8x1m pulses at 60m intervals:8L:8D	95.6	58.2	116
4.	*8L:8D:8x1m pulses at 60m intervals	93.9	57.8	115
5.	16L:8D	94.9	57.1	117
	S.E. of each mean :	0.85	0.47	1.03

*Treatments 2 and 4 started the 8h base photoperiod at 08.00h; treatment 3 started its 8h photoperiod at 16.00h.

experiment 1. Feed consumption was measured for five weeks (30-34 weeks of age) on a weekly basis in all rooms; The experiment was initiated when the birds were 29 weeks old and terminated after 5 weeks.

RESULTS

Rate of lay : Different phasing of the three intermittent lighting regimes (2,3 and 4) did not affect rate of lay and there was on difference between the mean rate of lay of the three intermittent groups and the long-day control (Table 2). The birds on the intermittent light and the long-day control were significantly more productive ($P<0.01$) than those on the short-day although the rate of lay was remarkably high for short-day control. The mean egg weight of the three intermittent light treatments was very similar to the long-day control (Table 2). The birds on the three intermittent lighting treatments (considered as a whole) consumed significantly ($P<0.05$) less feed than the long-day control birds.

The results given in Table 2 show that phasing the intermittent lighting before the main photoperiod did not affect therate of lay. The determination of the minimum duration of the pulse (i.e. one minute) needed for normal reproduction suggested the need for further definition of the minimum frequency of this light pulse required to induce an adequate stimulus.

Experiment 3

Following experiment 2, rooms were reallocated to new treatments, expcept those two rooms previously on 8L : 16D which were continued on 8L : 16D as negative controls. The pens of birds on treatments 2,3,4 and 5 in the previous trial were ranked according to their mean rate of lay during the last two weeks of the experiment. These rooms were then divided into 4 blocks, having four pens in each block; the best in the first block and the lowest producing pens in the 4th block. Each treatment was then randomly assigned to one pen from each block. The mean photoperiod of all treatments began at 08.00h.

The response measured with these lighting schedules was rate of lay. The experiment was started with 36 weeks old pullets and terminated after six weeks when the birds were 42 weeks old.

RESULTS

Rate of lay : Mean rate of lay of the last 4 weeks of the experiment is given in Table 3. One minute pulses given at hourly intervals provided an adequate

Table 3. *The effect of decreasing the frequency of the light pulse on the rate of lay of Rosa Tint pullets (each treatment consisted of 4 lots of 24 birds except treatment one which had only 2 lots)*.

Treatment No.	Treatment	Eggs/100 bird days (39-43 weeks of age)
1.	8L : 16D	86.4
2.	8L : 8xlm pulses at 60m intervals : 8D	90.2
3.	8L : 8xlm pulses at 120m intervals : 8D	86.8
4.	8L : 8xlm pulses at 240m intervals : 8D	85.0
5.	16L : 8D	89.8
	S. E. of mean (treatments 2-5) :	1.08
	S. E. of mean (treatment 1) :	1.53

stimulus (treatment 2) which was very similar to the long-day control (16L : 8D) but reducing the frequency to one every 2 hours or one every 4 hours (treatments 3 &4) led to a significantly lower rate of lay.

DISCUSSION AND CONCLUSIONS

The results presented in Table 3 indicated that frequency of 1-minute pulses spaced at hourly intervals was close to the minimum; further reductions in the frequency (treatments 3 & 4) tended to reduce the rate of lay. Four 2-hourly or two 4-hourly pulses did not produce any stimulus over the 8 h main photoperiod, rather the two regimes were very similar to the short-day control in their reproductive response.

It may be concluded that to substitute 8 h of normal lighting with 1-minute pulses of light, the minimum frequency of pulses is one every hour to induce normal stimulation in the domestic fowl.

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