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# Effects on White Leghorn Hens of Constant Exposure to Ultraviolet Light from Insect Traps

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# EDUCATION AND PRODUCTION

## Effects on White Leghorn Hens of Constant Exposure to Ultraviolet Light from Insect Traps[1,2]

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**ABSTRACT** Constant exposure of Hy-Line® W-36 White Leghorn hens to ultraviolet light from insect traps resulted in no significant differences in egg production, fertility, hatchability of fertile eggs, or total hatchability. Also, there were no apparent effects on the eyes of the birds. Results were the same when either blacklight or blacklight blue tubes were used. The need for additional testing of light traps for nuisance fly control in commercial caged layer houses is discussed.

(*Key words*: egg production, fly traps, ocular abnormalities, fertility, hatchability)

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## INTRODUCTION

The design and use of artificial lighting systems has enabled the poultry industry to maintain laying hens in indoor housing and minimize the seasonal effects of natural lighting on the laying cycle (Moore and Mehrhof, 1946; Lanson and Sturkie, 1961; Cunningham, 1988; Banks and Koen, 1989); however, the proper wavelengths of light are required to produce the desired effects. For example, Harrison *et al.* (1969) determined that White Leghorn chickens (both males and females) reared and maintained under red light matured later, and that the hens maintained a higher rate of lay than hens reared and maintained under blue and green light. Also, the rate of lay of hens maintained under blue and green light improved significantly after a change to red light (Harrison *et al.*, 1969).

Ultraviolet light apparently has little, if any, effect on egg production. In a study by Barott *et al.* (1951), egg production was increased significantly by exposure of birds to ultraviolet light in the bacteriocidal region (wavelength: 200 to 280 nm). In other studies, there was no indication of increased egg production when hens were exposed to ultraviolet light (Hart *et al.*, 1925; Titus and Nestler, 1935; Carson and Beall, 1955).

Traps that attract flies with ultraviolet light have been tested with varying degrees of success in open-sided (Driggers, 1971; Foil and Hogsette, 1994) and closed (Rutz *et al.*, 1988; Pickens *et al.*, 1994) caged-layer houses. Light traps are rarely recommended for use in open-sided poultry houses because they are ineffective unless operated only at dawn and dusk (Driggers, 1971). However, in closed housing, constantly operating ultraviolet light traps may be a viable alternative to chemically based fly control. Unfortunately, testing has been limited because the effects on laying hens of constant exposure to the ultraviolet light produced by insect light traps have not been defined (Rutz *et al.*, 1988).

There has been some discussion about whether diurnal birds in general, and chickens in particular, can detect light in the ultraviolet region. Research shows that diurnal birds have a high spectral sensitivity to light at wavelengths < 400 nm, i.e., the near ultraviolet range. Also, it has been reported that the lens of the avian eye can transmit wavelengths as short as 350 nm (Holden 1983).

Constant exposure to high intensity ultraviolet light has been shown to cause conjunctivitis in chickens (Barott *et al.*, 1951); however, the effects of constant exposure to ultraviolet light emitted from insect traps on the eyes of laying hens has not been examined.

The purpose of this study was to determine the effects on White Leghorn hens of constant exposure to ultraviolet light from insect traps. Variables measured were egg production, fertility, and hatchability. Eyes were examined for abnormalities induced by constant exposure to ultraviolet light. Favorable results in this study should encourage producers to allow constant-exposure testing of ultraviolet light traps in commercial caged-layer houses.

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**TABLE 1. Design for ultraviolet light exposure experiments**

| Date and experiment | Treatment and duration (week) |
|---|---|
| 1993, Experiment 1 | |
| 21 Sept to 11 Oct | Acclimation period (3) |
| 12 Oct to 23 Nov | Ultraviolet lights in Houses 2 and 3 (6) |
| 24 Nov to 4 Jan (1994) | Ultraviolet lights in Houses 1 and 4 (6) |
| 1994, Experiment 2 | |
| 27 Jan to 31 Jan | Acclimation period (5 d) |
| 1 Feb to 15 Mar | Blacklight blue lights in Houses 1 and 4 (6) |
| 16 Mar to 26 Apr | Blacklight blue lights in Houses 2 and 3 (6) |
| 27 Apr to 7 Jun | Ultraviolet lights in Houses 1 and 4 (6) |
| 8 Jun to 19 Jul | Ultraviolet lights in Houses 2 and 3 (6) |
| 20 Jul to 16 Aug | 1st month of 6-mo period of lay, lights remained in Houses 1 and 4 (4) |
| 17 Aug to 13 Sep | 2nd mo (4) |
| 14 Sep to 11 Oct | 3rd mo (4) |
| 12 Oct to 8 Nov | 4th mo (4) |
| 9 Nov to 6 Dec | 5th mo (4) |
| 7 Dec to 3 Jan (1995) | 6th mo (4) |

## MATERIALS AND METHODS

Hy-Line® W-36 White Leghorn hens were housed individually in 20 cages in each of four environmentally controlled houses (3.2 × 3.7 m) at the University of Florida Poultry Unit, Gainesville, FL. Air temperature was maintained at 32.2 C and relative humidity was ambient. The lighting schedule was 17 h light:7 h dark, with light in each house provided by two fluorescent loop bulbs (13-W Osram Dulux S, F13TT/27K). The same lighting schedule was maintained throughout the tests and was completely independent of additional light provided when ultraviolet light traps were in operation. Standard laying diets and water were provided for *ad libitum* consumption.

One ultraviolet light trap[3] was placed in two of the four houses. Each trap was oriented vertically and was approximately 2 m from, and facing the birds. Traps were fitted with two blacklight (40-W Sylvania, F40BL) or blacklight blue (40-W Sylvania, F40BLB) fluorescent tubes. Light traps were in constant operation during test periods. However, fluorescent tubes were replaced after 6 mo of continuous use to ensure that maximum emission of wavelengths in the desired range (310 to 390 nm) was maintained. All tubes were illuminated for 200 h prior to use to allow phosphors in the tubes to stabilize.

Test Houses 1 to 4 were located spatially at the corners of a rectangle, the houses at opposite diagonals being selected to receive like treatments. Houses not receiving ultraviolet light traps were used as controls. The first group of birds, hatched September 28 (Experiment 1), was housed on the following September 21 (51 wk old) and allowed to acclimate for 3 wk (Table 1). Light traps with blacklight tubes were operated in houses 2 and 3 for 6 wk, then moved to Houses 1 and 4 and operated for 6 wk. The second group of birds, hatched July 17 (Experiment 2), was housed on January 27 (28 wk old) and allowed to acclimate for 5 d. Light traps with blacklight blue tubes were operated in Houses 1 and 4 for 6 wk, then moved to Houses 2 and 3 and operated for 6 wk. Subsequently, the light traps (this time with blacklight tubes) were operated in Houses 1 and 4 for 6 wk, then moved to Houses 2 and 3 and operated for an additional 6 wk. The light traps were not moved again after this time, but remained in operation for six consecutive 4-wk periods to monitor the long-term effects of constant exposure to ultraviolet light. Eggs were collected daily and hen-day production (adjusted for mortality when necessary) was calculated for each 6-wk exposure period, and for each of the six 4-wk periods.

After the light traps had been in place for approximately 22 wk in Experiment 2, hens in each of the treated and control houses were artificially inseminated with semen collected from Single Comb White Leghorn males (Hy-Line® W-36) that had been maintained under controlled lighting. Males had not been exposed to the ultraviolet light traps. Eggs collected on Days 2 to 7 following insemination were incubated using standard procedures. Fertility, hatchability of fertile eggs, and hatchability of eggs set were calculated for treated (exposed) and control (not exposed) groups.

After Experiment 2 was terminated, five chickens each from the treated and control groups were euthanatized by cervical dislocation. The eyes were excised and fixed by submersion in formalin, hemisected, and embedded in paraffin. Sections (40 $\mu$m) of the cornea and retina of each eye were stained using cresyl echt violet and examined for any abnormalities.

Data were analyzed initially with the GLM procedure (SAS Institute 1985). Location effects within and between houses were not significant, therefore PROC *t* test procedures (two-tailed) (SAS Institute 1985) were used to determine differences between treatments. Percentage values were analyzed after transformation by arc sine(square root(percentage/100)). Actual values are reported in tables. Unless otherwise stated, $P = 0.04$.

[3]Night Eagle, Model 605, Don Gilbert Industries, Jonesboro, AR 72401.

**TABLE 2. Hen-day production of White Leghorn hens maintained with and without exposure to ultraviolet light from fly traps**

| Date and experiment | Hen-day production | |
|---|---|---|
| | Control | Ultraviolet light trap |
| | (%) | |
| 1993, Experiment 1 (6-wk exposures) | | |
| 21 Sep to 11 Oct (3-wk acclimation) | 77.98 | 78.50 |
| 12 Oct to 23 Nov | 79.48 | 80.07 |
| 24 Nov to 4 Jan (1994) | 74.70 | 74.21 |
| $\bar{x}$ | 77.38 | 77.59 |
| 1994, Experiment 2 (6-wk exposures) | | |
| 1 Feb to 15 Mar | 59.94 | 57.67 |
| 16 Mar to 26 Apr | 84.83 | 86.16 |
| 27 Apr to 7 Jun | 79.71 | 80.80 |
| 8 Jun to 19 Jul | 88.93 | 87.32 |
| $\bar{x}$ | 78.35 | 77.99 |
| 1994, Experiment 2 (4-wk exposures) | | |
| 20 Jul to 16 Aug | 78.76 | 82.54 |
| 17 Aug to 13 Sep | 69.18 | 70.04 |
| 14 Sep to 11 Oct | 68.12 | 72.85 |
| 12 Oct to 8 Nov | 72.71 | 74.14 |
| 9 Nov to 6 Dec | 69.80 | 71.26 |
| 7 Dec to 3 Jan (1995) | 71.73* | 79.19* |
| $\bar{x}$ | 71.72 | 75.00 |
| Grand $\bar{x}$ | 75.06 | 76.52 |

*Values significantly different ($P = 0.05$) based on the Student $t$ test (SAS Institute, 1985).

Initially, it was expected that treatment-induced changes (if any) in egg production would materialize within the first 14 d of exposure to ultraviolet light. Thus, when production data were recorded during each 6-wk exposure period, data from Weeks 1 and 2 were summarized separately from the remaining 4 wk of data. However, preliminary analysis showed that egg production within or between these groups was not significantly different, and data for Weeks 1 and 2 and Week 3 to 6 were pooled for final analysis.

## RESULTS AND DISCUSSION

There were no significant differences in egg production for Experiment 1 (Table 2). Production values for Experiment 1 were very similar and numerical differences were small. For unknown reasons, production in Experiment 2 was quite low during the first 6-wk exposure period; however, differences between the treatment and control groups were not significant ($t = 0.1332$; df = 30; $P = 0.90$). Also in Experiment 2, there were no significant differences between treated and control groups when birds were exposed to blacklight blue tubes (February 1 to March 15, and March 16 to April 26) or blacklight tubes (April 27 to June 7, and June 8 to July 19). There were no significant differences in production during the 4-wk exposure periods in Experiment 2 except during Period 6 ($t = –2.5327$; df = 6; $P = 0.04$) (Table 2). In this case, as was the case for all 4-wk exposure periods of Experiment 2, production was numerically higher when birds were exposed to the ultraviolet light.

No significant differences in fertility existed between treated and control birds ($t = –0.0601$; df = 14; $P = 0.95$), although on average, the fertility of treated birds was lower than that of control birds, 91.7 and 94.7%, respectively. There was no significant difference in hatchability of fertile eggs ($t = –0.4742$; df = 14; $P = 0.64$) or hatchability of eggs set ($t = –0.5254$; df = 14; $P = 0.61$) between treated and control birds. Hatchability of fertile eggs was 47 and 62% in treated and control birds, respectively, and hatchability of eggs set was 43 and 58% in treated and control birds, respectively. The comparatively low values appeared to have been a result of an incubator malfunction.

Examination of the eyes of the hens revealed no corneal or retinal abnormalities that could be attributed to treatment. Barott *et al.* (1951) reported the development of conjunctivitis in layers after a very short direct exposure to ultraviolet light, but light used in their study was more intense and in shorter wavelengths than that used here.

In summary, no changes in egg production, fertility, hatchability of fertile eggs, hatchability all eggs set, or eye condition resulted when White Leghorn hens were exposed to ultraviolet light from insect traps. In Experiment 2, the birds were exposed to ultraviolet light for essentially 7 mo without any detrimental effects (Table 2). This result was expected, based on previous studies (Hart *et al.*, 1925; Titus and Nestler, 1935; Barott *et al.*, 1951; Carson and Beall, 1955).

We neither expected nor found differences in production when either blacklight or blacklight blue tubes were used (Tables 1 and 2). If adverse effects were to have occurred, we would have expected these to be a result of exposure to the blacklight tubes rather than the blacklight blue tubes. This is because the blacklight tubes have a higher intensity and a more defined peak of radiant energy in the ultraviolet region (357 nm) than do blacklight blue tubes with the same phosphor (Pickens, 1989). The blacklight blue tubes were tested because some companies that produce light traps for insect control promote the use of blacklight and blacklight blue tubes together in the same trap, putatively to increase the attractiveness of the trap. Although blacklight tubes attract more flies than blacklight blue tubes or blacklight and blacklight blue tubes together (Pickens, 1989), our results indicate that neither blacklight nor blacklight blue tubes should cause adverse effects when used for extended periods near laying hens.

When Rutz *et al.* (1988) conducted their evaluation of light traps for fly control in closed caged-layer houses, they could only operate their traps during the hours when the automated lighting systems were in operation because of concerns about the possible effects that light from traps in constant operation might have on the laying cycle. Harrison *et al.* (1969) demonstrated that red

wavelengths of light stimulate egg production, but blue wavelengths do not.

Our study indicated that constant operation of ultraviolet light traps does not adversely effect egg production. Thus, the testing of ultraviolet light traps in closed caged-layer houses should not be restricted. Ultraviolet light traps may be most efficacious when they are the only lights in operation. However, the full potential of ultraviolet light traps for nonchemical fly control in closed poultry houses will not be understood until the traps are tested in commercial facilities independently of automatic lighting systems.

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## REFERENCES

Banks, P. A., and T. B. Koen, 1989. Intermittent lighting regimens for laying hens. Poultry Sci. 68:739–743.

Barott, H. G., L. G. Schoenleber, and L. E. Campbell, 1951. The effect of ultraviolet radiation on egg production of hens. Poultry Sci. 30:409–416.

Carson, J. R., and G. Beall, 1955. Absence of response by breeder hens to ultraviolet energy. Poultry Sci. 34:256–262.

Cunningham, D. L., 1988. Comparison of the Cornell and Biomittent reduced lighting programmes for laying hens. Br. Poult. Sci. 29:265–271.

Driggers, D. P., 1971. Field evaluation of blacklight electrocutor grid traps for the control of flies associated with poultry. M.S. thesis, University of Florida, Gainesville, FL.

Foil, L. D., and J. A. Hogsette, 1994. Biology and control of tabanids, stable flies and horn flies. Rev. Sci. Tech. Off. Int. Epizoot. Paris 13:1125–1158.

Harrison, P. C., J. McGinnis, G. Schumaier, and J. Lauber, 1969. Sexual maturity and subsequent reproductive performance of White Leghorn chickens subjected to different parts of the light spectrum. Poultry Sci. 48:878–883.

Hart, E. B., H. Steenbock, S. Lepkovsky, S.W.T. Kletzien, J. G. Halping, and O. N. Johnson, 1925. The nutritional requirement of the chicken. V. The influence of ultraviolet light on production, hatchability, and fertility of the egg. J. Biol. Chem. 65:571–595.

Holden, A. L., 1983. Special senses. Pages 345–363 *in*: Physiology and Biochemistry of the Domestic Fowl. B. M. Freeman, ed. Academic Press, London, UK.

Lanson, R. K., and P. D. Sturkie, 1961. The influence of light and darkness upon the reproductive performance of fowl: 1. Effect of continuous, intermittent, and flashing light on egg production, feed consumption, and body weight. Poultry Sci. 40:1751–1756.

Moore, O. K., and N. R. Mehrhof, 1946. Periodic increase in lighting versus continuous lighting for layers. Fla. Agric. Exp. Sta. Bul. 420:1–12.

Pickens, L. G., 1989. Relative attractiveness of paired BL and BLB fluorescent bulbs for house and stable flies (Diptera: Muscidae). J. Econ. Entomol. 82:535–538.

Pickens, L. G., E. T. Schmidtmann, and R. W. Miller, 1994. How to control house and stable flies without using pesticides. USDA, Agricultural Information Bulletin Number 673. USDA, Washington, DC.

Rutz, D. A., G. A. Scoles, and G. G. Howser, 1988. Evaluation of fly-electrocuting black light devices in caged-layer poultry facilities. Poultry Sci. 67:871–877.

SAS Institute, 1985. SAS/STAT® Guide for Personal Computers Version 6 Edition. SAS Institute, Cary, NC.

Titus, H. W., and R. B. Nestler, 1935. Effect of vitamin D on production and some properties of eggs. Poultry Sci. 14: 90–98.