Understanding Poultry Lighting:
A Guide to LED Bulbs and Other Sources of Light for Egg Producers

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An Introduction to Poultry Light Biology

Light is an essential aspect of poultry production. In most housing systems, artificial light is utilized to maximize production in pullets, layers and breeders. Today, a variety of different bulbs are available to illuminate the inside of a poultry house, all of which have benefits and shortcomings. Understanding the different lighting options available for poultry, as well as the terminology and management of light, is essential to achieve the best production.

Light is critical for egg production and pullet growth. Domestic poultry see and respond to a different range of light color spectra and have different spectral intensity responses than humans. While humans respond to light from around 400–750 nm, chickens can see from UV-A light (315–400 nm) to 750 nm. Additionally, the magnitude of sensitivity for red and blue spectra is much higher for chickens with additional peaks of light sensitivity around 480 nm and 630 nm. Chickens detect light not only through the retinal cone receptors in the eyes, but also via extra retinal photoreceptors in the pineal gland and the hypothalamic gland. The response to light controls the circadian rhythm, a 24-hour cycle in the bird's hormonal and behavioral aspects. In poultry, red light is vital for stimulating sexual maturity and egg production. Birds exposed to red light versus blue, green, or white light consistently have higher egg production than the other color groups.

Chickens are affected by the duration, intensity and spectrum of light. Light can be utilized as a management tool to help optimize pullet growth, age of sexual maturity, egg weight and egg production in laying hens in a variety of environments.

- Duration – As a general rule, decreasing light duration is utilized for growing pullets and increasing light duration is used to stimulate layers. Light stimulation (usually an increase of as little as one hour) has an immediate effect on the production of reproductive hormones. The standard level of light for maximum production is 16 hours. It is ideal to reach 16 hours of light by 30–35 weeks to help prolong peak production.

- Spectrum – Understanding the color spectrum given off by a light source will assist producers in selecting a light bulb which can deliver the proper amounts of red, green and blue light. Light bulb color can be expressed in degrees Kelvin (K) and color rendering index (CRI). However, neither of these measurements expresses the spectral peak intensity in the red, green, and blue spectra that are important for poultry growth and production. Overall, pullets may be reared with warm or cool lights, but laying hens should have lights with a sufficient red spectrum (2700K–3000K).

- Intensity – Light intensity is also important for poultry production. In general, light intensity below 5 lux is too dark to stimulate proper growth and production; while higher light intensity (>50 lux) may cause nervousness and aberrant behavior. The standard recommendation for growing pullets is to brood for 2 to 3 weeks at 30–50 lux, and then dim to 10–15 lux until 14 weeks. Two weeks prior to the transfer, gradually increase the light intensity to match the levels in the layer house. Laying hens should be kept at an average of 30 lux at the level of the feed trough.

Maintaining uniform light intensity in a modern poultry facility can be difficult. To measure light distribution in conventional cage or colony houses with manure belts, it is ideal to take a measurement at the feed trough in front of every cage, or at least every 50 cm (or 2 feet) between lights and at every level. This will typically require between 12 and 50 light readings to accurately assess the light distribution. In floor houses, measure at the wall, at feeder and drinker lines beneath the lights and 2–3 times in between lights for a total of 10 to 50 measurements. In open-sided houses, use window shades and curtains to prevent direct sunlight from coming into the house. Even with these interventions, the light intensity in open houses can easily reach above 1000 lux.

Available Light Sources

Many different types of light sources are utilized in the poultry industry, ranging from open houses under the influence of the sun to the most technologically advanced layer houses with the newest equipment without exterior light influence. All of these light sources have benefits and shortcomings; therefore, understanding the spectral composition of different light sources is important for selection amongst multiple lighting types. Light emitting diode (LED) light bulbs are becoming more common for use with poultry around the world because they are energy-efficient, full-spectrum and long-lasting.

Benefits of LED Bulbs:

- Provides a full spectrum of light
- Typically the most efficient light bulb measured in lumens per watt
- Because LEDs do not emit infrared radiation (heat), they can be constructed out of non-glass materials that are waterproof and shatterproof.
- Typically manufactured from non-toxic materials
- Can be designed to focus the light onto desired areas
- Color spectrum of the light can be adjusted depending on phosphors used.
- Easier to dim than CFL bulbs
- Dimming can extend the lifespan of the bulb
- Very long lifespan – up to 10 years at 16 hours per day (50,000 – 60,000 hours)
- Rapidly reaches peak light intensity after being turned on
- Ideal for areas where lights are frequently turned on and off
- Efficient in cold weather with no change in performance

Shortcomings of LED Bulbs:

- Expensive
- Must use the proper dimmer, otherwise the light may flicker and burn out more quickly.

- LED light is directional and requires an appropriate lens to focus light, or appropriate diffusers to cover a broader area
- May need to change wiring in a house to fit the ideal LED electrical specifications.
- The efficiency of heat fins is reduced with dust build-up, poor ventilation around the bulb, or putting the bulb in a "jelly jar" for waterproofing.
- Lights may not burn out after expected lifespan but will be dimmed greater than 70% of original lumen output. As a result, baseline lux testing in the house may be required to determine when bulbs should be changed.
- Cheaper LED lights may not have an appropriate heat sink, spectrum, hardware or warranty for poultry environments.

Choosing the Best LED Bulb for your Chicken House

1. Poultry-specific LED lights: Although the most expensive, poultry-specific LED lights are engineered for poultry vision, and their manufacturers understand the needs of the poultry industry. These lights are typically rated to withstand cleaning and disinfection procedures in a chicken house.

2. General LED lights rated for agricultural use: General agriculture-grade LED lights usually withstand the environmental conditions of a poultry house. While these lights are less expensive, understanding their full details (including light output, spectrum, warranty and level of waterproofness) is important before installation. These lights are usually similar to standard LED lights, but usually have a different warranty.

3. Standard household LED lights: Standard household LED lights have also been successfully used in poultry houses. While some lights may not withstand the poultry house environment, many farms have had success using inexpensive LED bulbs that replace the CFL lights already in the house. With low cost LED bulbs, the return on investment from energy savings may pay for the bulb in 12 – 24 months depending on the bulb that was replaced.

Overall, different types of LED bulbs have different ideal uses. Very directional lights (30–50°) placed closely together on 6–8-foot centers (1.8–2.4 m) can provide even lighting in tall caged houses. Very broad lights (>180°) are more effective for floor and aviary houses. Lights with medium directionality (90–150°) can be used in a variety of environments, depending on the spacing and the luminous flux.

Conclusion

Light duration, spectrum and intensity are critical for optimum peaks and sustained egg production. While there are many choices in lighting available to the poultry producer, LED lights are becoming increasingly popular due to the combination of energy efficiency, reliability and long bulb life. As the use of LED lights increases, the understanding of proper application in various housing types will increase. Lower product costs and improved efficiency and application of LED lights can be expected in the future.

***The content of this presentation and proceedings paper is the work of Dr. Ian Rubinoff, DVM, MPH, DACPV, a technical services veterinarian with Hy-Line International. Please access the full "Understanding Poultry Lighting Technical Update" at**

http://www.hyline.com/aspx/resourcelibrary/downloads.aspx, available in both English and Spanish.