POULTRY SCIENCE AND TECHNOLOGY GUIDE

Extension Poultry Science • North Carolina State University • Raleigh, N.C.

Selecting Light Sources for Poultry

Incandescent lighting has been the primary source of artificial light for poultry. However, it is inefficient because 70 percent of the energy that an incandescent lamp consumes is converted to infrared radiation (heat). A number of light sources are more efficient producers of visible light. Not all alternative light sources are practical, however. A suitable light source should meet the following tests:

- It should result in at least equal bird performance (weight gain, feed conversion, and egg production) to the light source being replaced;
- It should provide adequate payback (offsetting of the purchase cost by reduced operating and labor costs).

To obtain performance at least equal to that of the light source being replaced, the new source should be selected carefully, taking into account the effects of wavelength (color of light) and intensity on bird performance.

Factors that affect the payback period include lamp and ballast life, lamp and ballast efficiency, lumen depreciation of the lamps, effects of the environment upon the lamps and ballasts, physical requirements of the light sources, light distribution characteristics, and the possibility of breakage or theft of the light sources.

Lamp and Ballast Life

Lamp life is an important criterion for determining payback (Table 1). In the breeder house, breeders receive approximately 5,040 total hours of light (natural and artificial). Incandescent lamps have the shortest life but are also the least expensive. Lamps are rated under a set of controlled circumstances (such as type of ballast, temperature, and voltage). These ratings are achieved under different conditions. Incandescent lamp life is based upon the survival of 50 percent of the lamps. Fluorescent lamp rating is the median life (50 percent remaining in operation) when lamps are operated for 3 hours per start. Mercury and high-pressure sodium (HPS) lamps are rated when 67 percent of the lamps have survived while operating at 10 hours per start. Table 1 gives the average life (in hours) of artificial light sources.

Table 1. Average Life of Artificial Light Sources

Type of Lamp	Average Hours of Life
100-watt incandescent (120V)	750
60-watt incandescent (120V)	1,000
60-watt incandescent (130V)	1,000*
25-watt incandescent	2,500
40-watt tube fluorescent	20,000
13-watt biaxial fluorescent	10,000
22-watt circlite fluorescent	12,000
75-watt mercury	24,000
100-watt high-pressure sodium (HPS)	24,000

*If used on 120 volts, life can be extended 3 to 4 times.

When the number of operating hours per start is different from the manner in which the lamps were rated, the life expectancy can change. Table 2 gives the life expectancy for mercury and high-pressure sodium lamps. Table 3 gives the life expectancy for fluorescent lighting.

Table 2. Life Expectancy of Mercury and High-Pressure Sodium Lamps

Starting Conditions (hours per start)	Life Expectancy (hours)
10	24,000
5	18,000
2.5	13,440
1.25	10,080

*Generally, high-pressure sodium lamps have a life expectancy significantly greater than these ratings.

Table 3. Life Expectancy of Fluorescent Lamps

Type of Lamp	1 Hour Per Start	3 Hours Per Start	12 Hours Per Start
40-watt tube		20,000	
13-watt biaxial		10,000	
22-watt circlite		12,000	16,000
44-watt circlite	5,000	7,500	

The end-of-life characteristics of most HPS lamps may cause management problems in the poultry house. As the lamp approaches its life expectancy, it cycles on and off and may go unnoticed. It is important to make sure the birds receive enough light. In fluorescent lamps, the tube near the electrodes darkens as the lamp ages.

Some biaxial-type fluorescent fixtures are single units (ballast and lamp), whereas others may allow for replacement of lamp and ballast independently. Generally the ballast lasts longer than the lamp.

Lamp Efficiency

The type of lamp is critical because electric bills are calculated upon the power consumed. The type of lamp can be selected based upon the lumens of light output produced per watt consumed. Table 4 gives the approximate lumens per watt for several types of lamps.

Table 4. Efficiency of Artificial Light Sources

Type of Lamp	Efficiency (lumens/watt)
Incandescent, 25 watt	9
Incandescent, 100 watt	17
Fluorescent tube (cool white), 40 watt	79
Fluorescent arclent (soft white), 44 watt	62
Fluorescent biaxial (warm white), 13 watt	69
Mercury, 75 watt	37
Mercury, 175 watt	49
High-pressure sodium (clear), 100 watt	95
High-pressure sodium (clear), 70 watt	90
High-pressure sodium (diffuse), 70 watt	83
High-pressure sodium (clear/deluxe), 70 watt	63

Ballast Efficiency

The ballasts for fluorescent and high-intensity discharge lamps consume energy. The power consumed by the ballast can vary depending upon the type of ballast and the manufacturer (see Table 5).

Table 5. Variation in Power Consumption

Manufacturer	Lamp Type and Wattage Rating	Power Consumed (watts)
X	50-watt high-pressure sodium	57.0
Y	50-watt high-pressure sodium	69.1
Z	13-watt biaxial fluorescent	16.1
Y	13-watt biaxial fluorescent	17.4

The ballast must be sized correctly for the particular lamp. A ballast rated for a smaller lamp will cause problems with starting. Different types of ballasts are available for some of the light sources, making them attractive for particular applications, but they may have less desirable energy efficiency characteristics.

Lumen Depreciation

As lamps age, the light output decreases. The amount of decrease depends upon the type of lamp (see Table 6). This is important if you do not want the light intensity in the poultry house to drop below a certain minimum level. You may need to replace lamps even before they fail to maintain the specified minimum light intensity.

Table 6. Light Output Ratings

Type of Lamp	Initial Lumen Rating	Mean Lumen Rating*	Decrease (percent)
Mercury, 75 watt	2,800	2,250	20.0
Fluorescent, 40-watt warm white	3,200	2,815	12.0
Fluorescent, 13-watt biaxial	900	810	10.0
HPS 70-watt clear	6,300	5,670	10.0
HPS 100-watt clear	9,500	8,550	10.0

*Mean lumen rating is lumens delivered by a lamp using a reference ballast after the lamp has operated to 40 percent of its rated life at 3 operating hours per start.

Environmental Effects

Low ambient temperatures have a detrimental effect upon the starting ability and lumen (light) output of some fluorescent lights. Information on the starting temperature rating of particular fluorescent lamps can be obtained from dealers. Reduced lumen output and poor starting is noticeable when it is below 40 °F to 55 °F in some poultry houses (breeder houses during cold weather). Low-temperature ballasts are available, but these ballasts are not as energy efficient as conventional ones. Manufacturers of some of the biaxial fluorescent lamps now rate their lamps to start at 0°F, but others are not rated as low.* Mercury and high-pressure sodium lamps will start at ambient temperatures of -22°F, and the lumen output is unaffected by low temperatures because of the double-envelope construction. The use of prismatics or globes over the fluorescent lights also minimizes ambient temperature effects.

Lighting engineers did not foresee the use of gas discharge lamps in poultry houses. Generally, the tube-type fluorescent fixtures have not performed as well in an atmosphere of high ammonia and moisture because of the increased exposure of the critical components. Corrosion of the contacts may cause reduced lumen output, premature fixture failure, and an increased current draw affecting lamp start.

Generally, biaxial fluorescent, mercury, and HPS fixtures are manufactured with much more protection from the harsh environment and should have a longer life expectancy. Industrial grade fluorescent tube fixtures hold up much better than the ordinary "shop grade" fixture.

*PL 5 and 7 rated to 0°F, while PL 9 and 13 are rated to 23°F.

Physical Requirements of the Lamps

Line voltage can affect the life expectancy of the lamps and ballasts. Voltage variations at the poultry house may not allow alternate light sources to be cost effective. Low voltage may cause starting problems, reduce light output, or destroy the ballast.

Dimming devices are sometimes used on lighting systems in poultry houses. High-pressure sodium, mercury, and most fluorescent lamps cannot normally be dimmed. However, solid-state ballasts are available for dimming fluorescents and are more efficient than the typical core and coil ballasts. The solid-state ballasts are more expensive and have a shorter life expectancy. One dimmable compact biaxial product is available.

Light Distribution

The distribution of light throughout a poultry house is important. It is generally thought that excessively bright or dark areas within the house need to be minimized. The high-intensity discharge lamps (HPS or mercury) usually have a prismatic lens that allows for more even distribution of light by directing a certain percentage of light in predefined directions.

Orientation of the lamps may influence the direction of the light output from the fixtures. When fluorescent lamps are oriented vertically (as in biaxial flourescent), most of the light is directed out to the side, rather than down toward the floor. This may be a problem in houses with high ceilings where a prescribed light intensity is to be directed at the birds.

Reflectors may be used with lights to increase the light intensity directed toward the birds. The cost of the reflector must of course be considered in the overall evaluation.

Breakage and Theft of Lamps

The high initial cost of some of the alternate light sources can become a concern if breakage and theft of lights become excessive. No lighting system can be economical if too many lamps are broken accidentally or stolen.

Numerous factors must be considered when deciding on the type of light source to be used in the poultry house. Evaluate your situation carefully before proceeding.

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Published by
THE NORTH CAROLINA COOPERATIVE EXTENSION SERVICE

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PS&T Guide No. 45

4/91—1M—TMD—910539