October 2015 EnergyWise[SM] Tip: Critter Vision

For the last several years, most everyone has heard how light-emitting diodes (LEDs) save energy while illuminating the dark corners of our world. In December 2014, *Bloomberg News* forecasted that LEDs will power half of all residential lights by 2016 and more than 70 percent by 2020.

When the sun goes down, or we go indoors, we turn "on" the light switch and expect LEDs to quickly provide the light we need to see. But with Nebraska being one of the leading livestock producing states, have you ever considered how turning on lights can impact the animals we raise?

First, we need to consider how humans use light to see. Lighting "efficiency" is often measured in lumens-per-watt of electricity with lumens representing a quantity of light. This does not tell the whole story for animal producers because lumens represent effective light for the human eye, and the way humans and most animals process light, basically "see," is quite different.

Humans' eyes are tri-chromants with sensitivity to red, green, and blue parts of the visible spectrum. Our nighttime peak sensitivity is at 550 nm (green) in the spectrum and it diminishes significantly in the red and blue areas to the left and the right in the spectrum. Humans rely entirely on absorbing photons through the photo-pigments rhodopsin (rods), iodopsin (cones), and melanopsin located on the retina in the back of our eyes.

While we might assume barnyard animals see in a similar way, nothing could be farther from the truth. Consider domestic fowl, such as chickens, turkey, ducks and geese. These birds are quad-chromants. Like humans, they have a peak sensitivity to green at 550 nm. But unlike humans, they also have enhanced sensitivity to reds, blues, and ultraviolet (UV) light. In addition, they not only absorb photons into their retinas, but also through functional photoreceptors located in the pineal gland on top of the brain and through deep encephalic photoreceptors on the hypothalamus. In some ways, you could say they have eyes on the back of their heads!

In addition, each color of light has a distinct effect on fowl physiology. Green light, for example, significantly increases growth rate at an early age by enhancing proliferation of skeletal muscle satellite cells. Blue light increases growth at a later age by elevating plasma androgens. Narrow-band blue light reduces locomotion. It also reduces their cannibalism rate at late age (especially in broiler chickens raised for human consumption). Together, green and blue light promote myofiber growth due to more effective stimulation of testosterone secretion.

Red light stimulates and promotes sexual activity and increases growth rates for chickens and turkeys at the beginning of the rearing period. It also increases locomotion, thereby minimizing leg disorders at the end of the rearing period. Furthermore, red light reduces the amount of feed consumption per egg laid with no differences in egg size, shell weight, shell thickness, or yolk and albumin weights while lengthening a laying hen's peak production period.

And these light-impact "oddities" are not limited to our winged friends. For example, milk yield is substantially impacted by light used around dairy cows. Optimum production requires cows to be exposed to a full spectrum with adequate intensity. High pressure sodium fixtures provide

high lumens-per-watt, but the light from these fixtures is biased towards longer wavelengths (yellows through reds) which cows cannot perceive. Fluorescent fixtures can provide ample effective light for dairy cattle. However, under cold conditions, light output of fluorescent fixtures can decrease by more than 40 percent and become inadequate simulation for the cow's production.

Concerns with lighting in hog confinement operations are mostly focused on energy costs and how long the lamps or fixtures last before needing to be replaced. Confinement barns are power-washed several times a year, so protecting lighting fixtures against water ingress is essential. For these reasons, compact fluorescent lamps (CFLs) are usually installed in "jelly jar" screw-in fixtures. The problem is, the enclosed operating conditions heat up the CFL ballasts and drastically reduce their lifetimes. This presents a problem, because replacing light bulbs is daunting in a facility in which the floor may be grated and is probably slippery, and hogs wander around the base of the ladder.

Finally, artificial lighting can cause an interruption of circadian and estrus cycles in cattle and especially horses. Producers often regulate these cycles to their advantage by creating an "artificial day" by using lights inside barns. But swine, cattle and horses cannot see red light, so dimming to a red spectrum at night enables workers to service the barn without disturbing the animals.

What source of lighting now solves all the concerns expressed above? The same one you should be putting into your favorite light fixture at home! LEDs are the most efficient and environmentally friendly of the agricultural lighting options, producing white light by combining a blue LED with red and green phosphors. While not exactly daylight, the LED spectrum provides a close approximation of daylight from a human's point of view, without the spectral gaps of other technologies that domestic animals require.

LEDs also have the longest lifetime (up to 10 years with 24/7 operation), are highly rugged, are not susceptible to shock or vibration, and allow for color shifting and color control. LEDs often have higher upfront costs, but these costs are quickly recouped through energy savings and better production levels, resulting in the lowest total cost of ownership for agricultural lighting options.

Your local utility and Nebraska Public Power District want to help you make the most of your energy dollar by helping you select the right lighting for your livestock needs. For more information on special lighting needs or ideas on how you can make your home or business EnergyWise[SM], along with possible energy efficiency financial incentives, contact your local utility or visit www.nppd.com.