e-GRO Alert

Roberto G. Lopez
rglopez@msu.edu

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Are there Risks of Working under LED Supplemental Lighting?

There are potential health risks associated with exposure to both solar radiation and electric light sources used for indoor, street, and horticultural lighting applications. Therefore, knowing the risks can help you take precautions.

Most greenhouse employees have become accustomed to the bright yellow radiation emitted from high-pressure sodium lamps (HPS; Fig. 1). However, light-emitting diode (LEDs) fixtures often have higher intensities than HPS lamps and emit purple, pink, or white light and can be a shock to workers especially on very cloudy days or at night (Fig. 1).

Figure 1. Greenhouse high-pressure sodium (HPS) lamp (above) and light-emitting diode (LED, left) supplemental lighting fixtures.

The recent addition of warning labels on high-intensity LED supplemental lighting fixtures, spec sheets and shipping boxes has raised concerns among greenhouse employees regarding the potential human health risks given that warnings are not found on HPS lamps. Therefore, in this article, the latest information regarding horticultural LED safety standards and the published risks associated with blue light will be covered. Note, that this information is always an evolving area of study.

Safety concerns regarding the narrow spectral compositions of horticultural LEDs has led international standard groups and diode manufactures to assess and evaluate the photobiological safety of LEDs. 2019, the American National Standards Institute (ANSI)/CAN/ Underwriters Laboratories (UL) 8800 (ANSI/CAN/UL 8800:2019) became the primary North American safety standard for horticultural lighting. It incorporates requirements from, the Safety Standard for Horticultural Lighting Equipment and Systems, for fire and electrical shock hazards; IEC 62471 (International Electrotechnical Commission), Photobiological safety of lamps and lamp systems, addressing optical radiation hazards; and IEC/TR 62471-2, Photobiological safety of lamps and lamp systems-Part 2: Guidance on manufacturing requirements relating to non-laser optical radiation.

Under ANSI/CAN/UL 8800:2019, a light source is subjected to a photobiological hazard assessment for both the skin and eyes per IEC 62471.

For the risk of blue light, the classification is as shown in Fig. 2.

Risk Group 0 or exempt (no risk) when the maximum exposure time is greater than 10,000 s

Risk Group 1 (low-risk) when the maximum exposure time is between 100 and 10,000 s

Risk Group 2 (moderate-risk) when the maximum exposure time is between 0.25 and 100 s

Risk Group 3 (high-risk) when the maximum exposure time is less 0.25 s (Fig. 4).

Given that UV radiation is not present in the vast majority of supplemental lighting fixtures, blue light and IR are the main wavelengths of potential concern.

Risk Group	Philosophical Basis
Exempt	No photobiological hazard
Group 1 (low-risk)	No photobiological hazard under behavioral limitations
Group 2 (moderate-risk)	Does not pose a hazard due to aversion response to bright light or thermal discomfort
Group 3 (high-risk)	Hazardous even for momentary exposure

Figure 2. Sources of optical radiation are classified into risk groups by IEC EN 62471:2006 subject to their potential photobiological hazard. This classification takes place through a risk assessment, which is conducted on the either individual components or the final product. If a source is assigned to a "safe" group (Exempt Group), or as low-risk, it is placed in the Risk Group 1 and would not be need a detailed workplace evaluation, since there is no photobiological safety hazard issue.

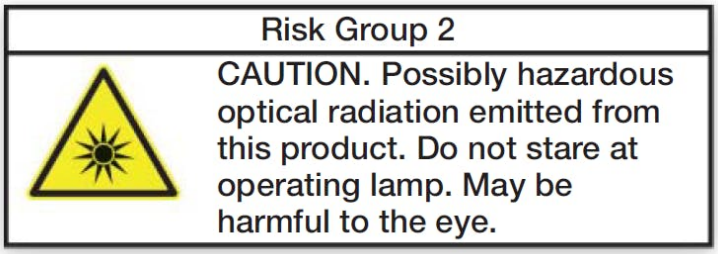

Figure 3. Signify Holding (Formally Philips Lighting) identifies their LED Production Modules 2.2, 3.0 and 3.1, all LED Toplighting Compact and all LED Toplighting Force as being in the Risk Group 2. The label indicates that you should not stare at the operating light source. The philosophical basis for this classification is that the lamp does not pose a hazard due to the aversion response to very bright light sources or due to the thermal discomfort.

Figure 4. A warning label on a custom LED fixture that emits UV radiation.

Figure 5. Roberto Lopez using polarized glasses when working under LED Supplemental lighting at night.

Figure 6. Examples of eyewear protection equipment used in a recent study: Photobiology eye safety for horticultural LED lighting: Transmittance performance of eyewear protection using high-irradiant monochromatic LEDs.

According to the American Medical Association (AMA), there are potential risks or dangers of excessive exposure to blue light. The example utilized by the AMA are of white LED street lighting, which emit a large amount of blue light.

The first risk which has received a lot of media attention is that tablets, laptops, smartphones, and TV screens emit blue light which can affect your circadian rhythm, our natural wake and sleep cycle. Exposure to blue light suppresses the secretion of melatonin, which regulates your sleep cycle.

Secondly, blue light also can pose a threat to your vision. According to Signify, prolonged staring into any light source might cause damage to the eye. However, due to the automatic aversion response of the human eye, you will generally never look directly into the light source for longer than 0.25 s. Additionally, if a fixture is labeled as a Risk group 2, do not look directly into the light source (Figure 3). If this cannot be avoided, (it is recommended to take one of these additional safety measures:

- Turn off the fixtures which are located near the worker and use common general lighting as work lighting
- Wear protective eyewear.

A recent study by Bo-Sen Wu and Mark G. Lefsrud was conducted to provide information on the transmittance performances of 12 eyewear protection products that included welding goggles, safety goggles, polarized glasses, and sunglasses. The researcher found that (7/12) of the products they tested could block 80% of high irradiance light between 400 to 700 nm and were adequate as protective personal equipment against light hazards. They concluded that individuals working under LEDs within this wavelength range could select welding goggles and

polarized glasses to avoid ocular light hazards. However, sun-glasses and safety goggles, are potentially inadequate to protect one's eyes from LEDs emitting IR or wavelength >700 nm. Additionally, they recommend that users consult transmitted spectrum data of their respective eyewear before use under LEDs.

Medical and Health Advice Disclaimer

The information, including but not limited to text, graphics, images, and other materials contained in this article are for informational purposes only. No material is intended to be a substitute for professional medical advice, recommendation, diagnosis, or treatment. Always seek the advice of your physician, optometrist and ophthalmologist or other qualified healthcare provider with any questions you may have in regard to working under LED lighting or the use of protective eyewear.

For more information on Horticultural Lighting Testing and Certification visit the UL website.

References:

AMA adopts guidance to reduce harm from high intensity street lights: https://www.ama-assn.org/press-center/press-releases/ama-adopts-guidance-reduce-harm-high-intensity-street-lights

Bo-Sen Wu and Mark G. Lefsrud. 2018. Photobiology eye safety for horticultural LED lighting: Transmittance performance of eyewear protection using high-irradiant monochromatic LEDs. J. of Occupational and Environmental Hygine 15(2):133-142.

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CONTRIBUTORS

Dr. Nora Catlin
Floriculture Specialist
Cornell Cooperative Extension
Suffolk County
nora.catlin@cornell.edu

Dr. Chris Currey
Assistant Professor of Floriculture
Iowa State University
ccurrey@iastate.edu

Dr. Ryan Dickson
Greenhouse Horticulture and
Controlled-Environment Agriculture
University of Arkansas
ryand@uark.edu

Thomas Ford
Commercial Horticulture Educator
Penn State Extension
tgf2@psu.edu

Dan Gilrein
Entomology Specialist
Cornell Cooperative Extension
Suffolk County
dog1@cornell.edu

Dr. Chieri Kubota
Controlled Environments Agriculture
The Ohio State University
kubota.10@osu.edu

Heidi Lindberg
Floriculture Extension Educator
Michigan State University
wolleage@anr.msu.edu

Dr. Roberto Lopez
Floriculture Extension & Research
Michigan State University
rglopez@msu.edu

Dr. Neil Mattson
Greenhouse Research & Extension
Cornell University
neil.mattson@cornell.edu

Dr. W. Garrett Owen
Greenhouse Extension & Research
University of Kentucky
wgowen@uky.edu

Dr. Rosa E. Raudales
Greenhouse Extension Specialist
University of Connecticut
rosa.raudales@uconn.edu

Dr. Alicia Rihn
Agricultural & Resource Economics
University of Tennessee-Knoxville
arihn@utk.edu

Dr. Debalina Saha
Horticulture Weed Science
Michigan State University
sahadeb2@msu.edu

Dr. Beth Scheckelhoff
Extension Educator – GreenhouseSystems
The Ohio State University
scheckelhoff.11@osu.edu

Dr. Ariana Torres-Bravo
Horticulture/ Ag. Economics
Purdue University
torres2@purdue.edu

Dr. Brian Whipker
Floriculture Extension & Research
NC State University
bwhipker@ncsu.edu

Dr. Jean Williams-Woodward
Ornamental Extension Plant Pathologist
University of Georgia
jwoodwar@uga.edu

Cooperating Universities

Cornell CALS College of Agriculture and Life Sciences

Cornell Cooperative Extension Suffolk County

Iowa State University

University of Kentucky

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UTIA Institute of Agriculture, The University of Tennessee

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