LED Safety: Transmission performance of 12 welding, safety goggles, and glasses using 10 high irradiance LEDs.

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Study Overview

Background There is rapidly increasing radiant flux in the latest solid-state light emitting diodes (LEDs), driven by increasing applications, such as display backlighting, medical services, general illumination, and horticultural lighting. In horticultural applications high-illuminant LEDs have been widely used for photosynthesis and to explore plant response since blue and red photons induce higher photosynthetic capacity than those in the green wavebands. However, it has been reported that blue light may lead to photochemical injury including ocular damage.

Research Objectives The objective of this work was to investigate transmission performances of different types of glasses under high irradiance level (1,000 W/m^2) for use in horticultural working areas. In this study 12 different models including welding goggles, safety goggles, polarized glasses, and brand name glasses (Table 1 and Fig. 1) were examined under 10 different monochromatic high-illuminant LED assemblies across visible spectrum for human (380-740 nm) (Fig. 2).

Table 1. The types and brands of 12 different glasses including welding goggles, safety goggles, polarized glasses, and brand name glasses which were examined in this study.

	Brand	type
1	McMaster-Carr	Welding goggles
2	McMaster-Carr	Welding goggles
3	McMaster-Carr	Welding goggles
4	Radnor	Safety Goggles
5	Stanley	Safety Goggles
6	Rayban	Polarized
7	Burberry	sunglasses
8	Fisherman	Polarized
9	zeroUV	Polarized
10	DXTREME	sunglasses
11	Chanel	sunglasses
12	Dereon	sunglasses

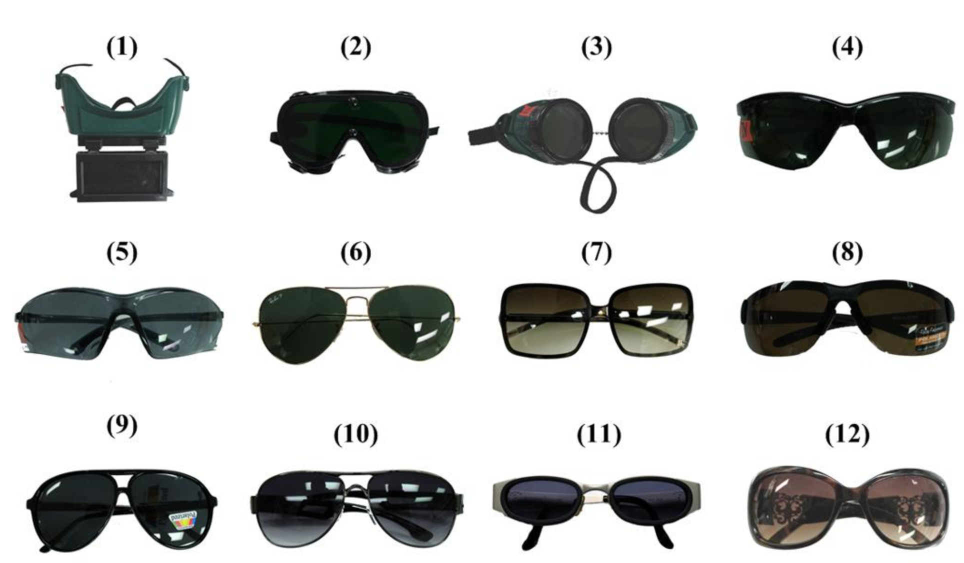

Fig 1. The pictures of 12 different glasses including welding goggles, safety goggles, polarized glasses, and brand name glasses which were examined in this study.

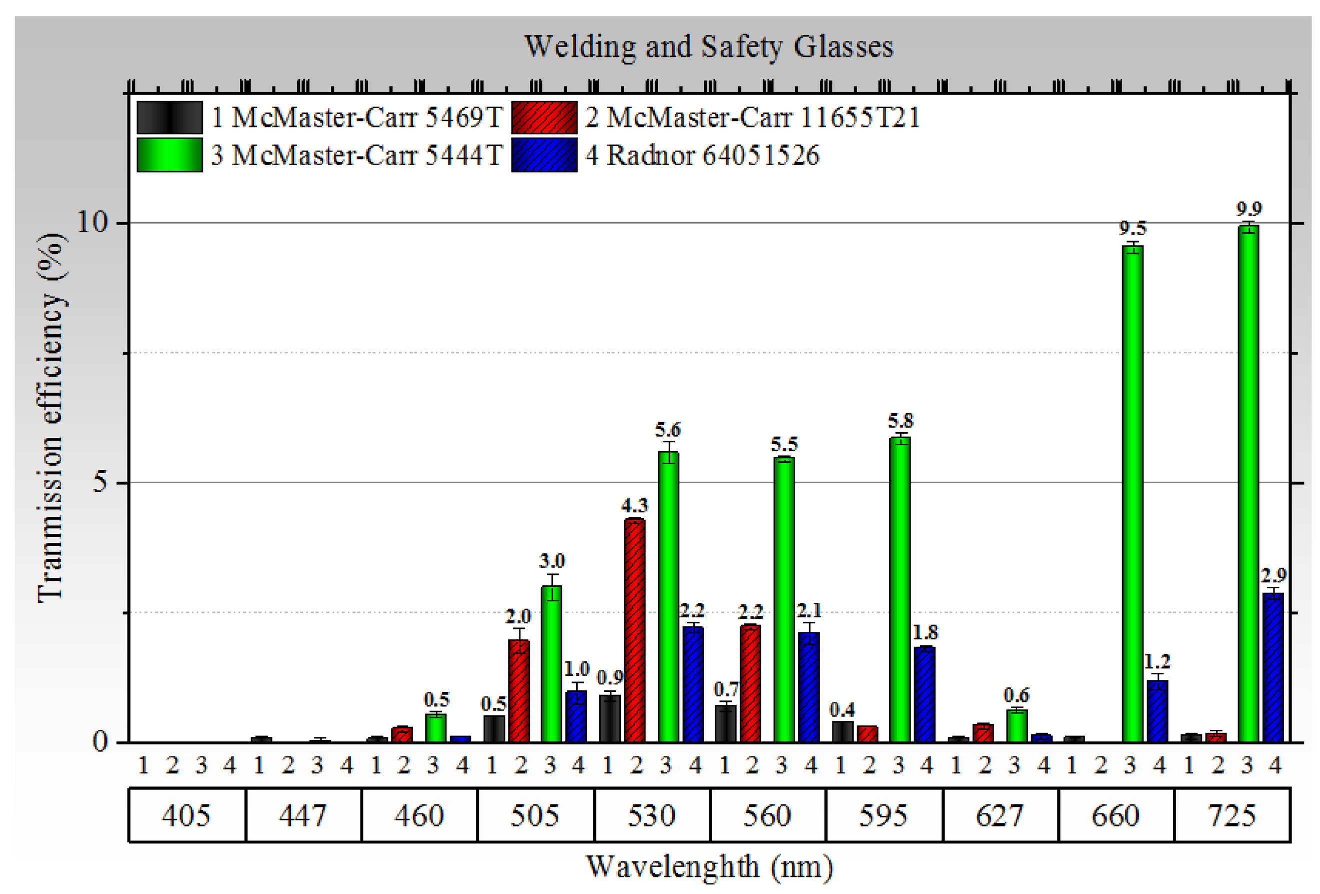

Fig 4. The transmission efficiencies of welding and safety goggles under each high-illuminant LED assemblies.

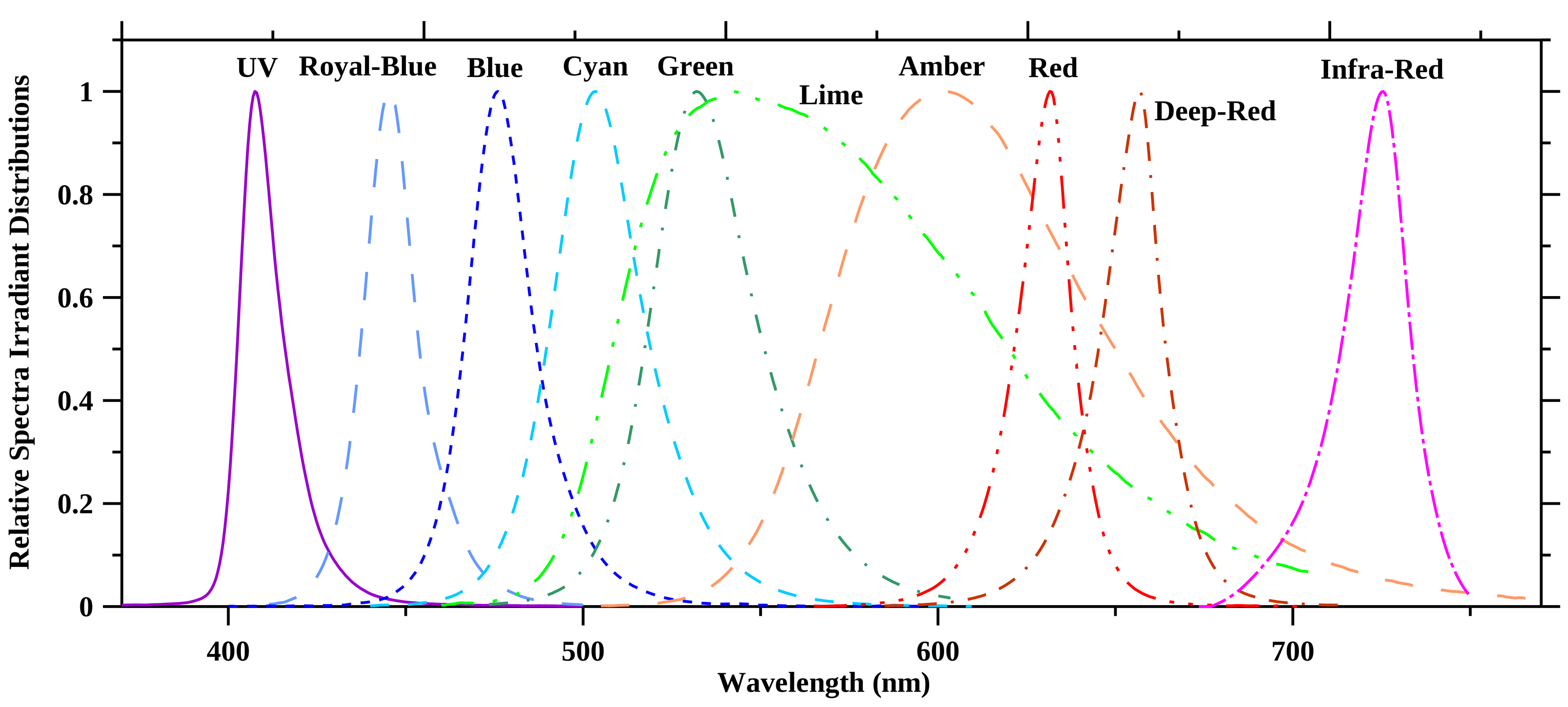

Fig .2 The spectra of 10 different monochromatic high-illuminant LED assemblies used in this study.

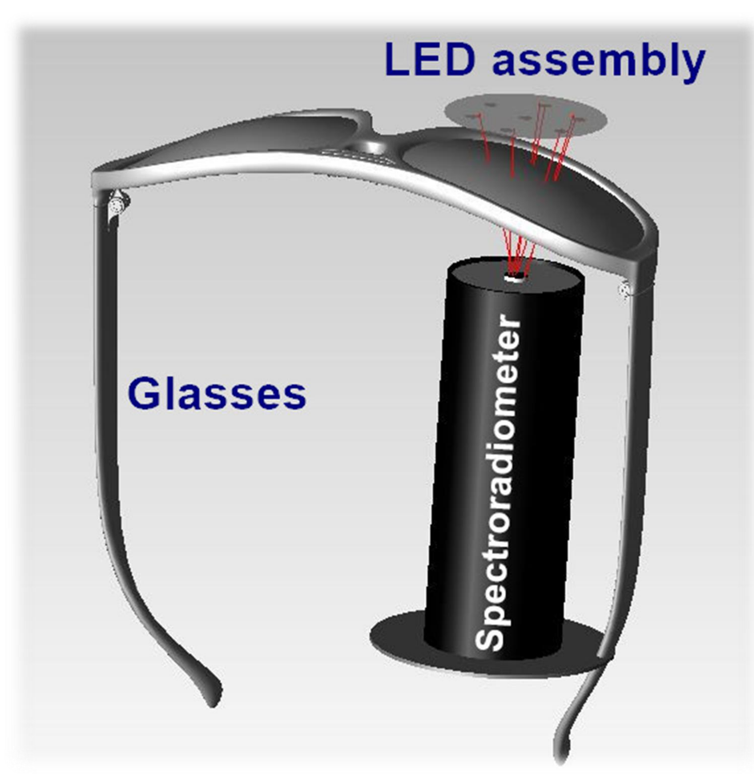

Fig 3. The experimental setup for the glasses transmission performance study.

Methodology

The experimental setup was shown in Figure 3. A spectroradiometer (PS-100; Apogee, Logan, UT, USA) was used to measure the irradiance levels of light outputs of high-illuminant LEDs irradiance with and without a goggle. The transmission of goggles was calculated by the following equation:

$$\textbf{Transmission}\ (\%) = \frac{\textbf{irradiance of lights penetrating goggles}}{\textbf{irradiance of natural or artificial lights}} * 100$$

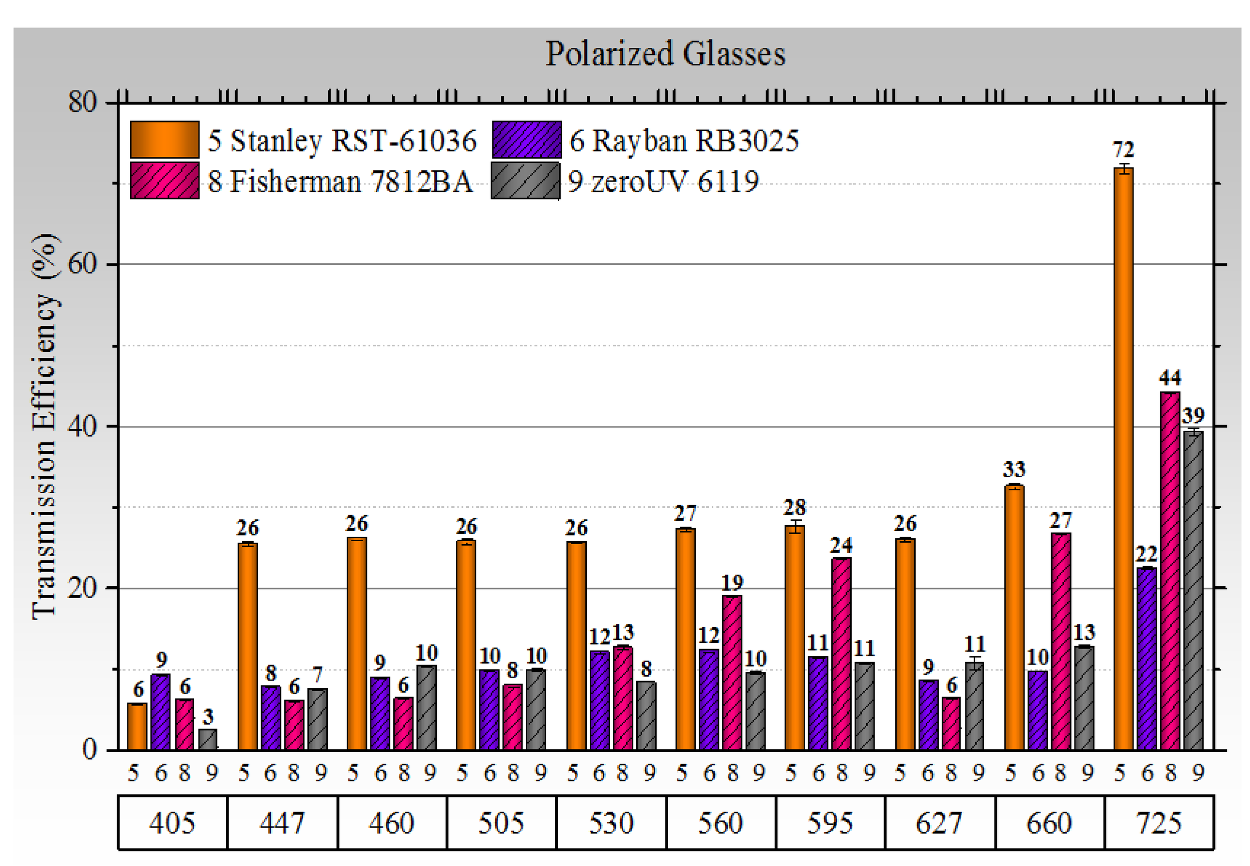

Fig 6. The transmission efficiencies of safety goggles and polarized sunglasses under each high-illuminant LED assemblies.

Results

The performance of transmission efficiencies of different glasses in visible spectrum for humans are showed in Figure 4-6. Overall, the irradiance level reduction from 400 to 700 nm was at least 90% for welding glasses (Fig. 4) and approximately ~80% for other glasses (Fig. 5 and 6). However, the irradiant reduction in the infrared waveband was only between 10-40% for brand name sunglasses and polarized glasses.

Conclusion

The transmission performance of 12 different glasses have been examined using high-illuminant LEDs across 400-725 nm in this study. Consumers and workers using LEDs in visible waveband (400-700 nm) can select ordinary safety glasses (tinted) to avoid ocular safety hazards. Brand name glasses and polarized glasses, however, should be avoided if infrared LEDs or LEDs emitting wavelength above 700 nm are used.

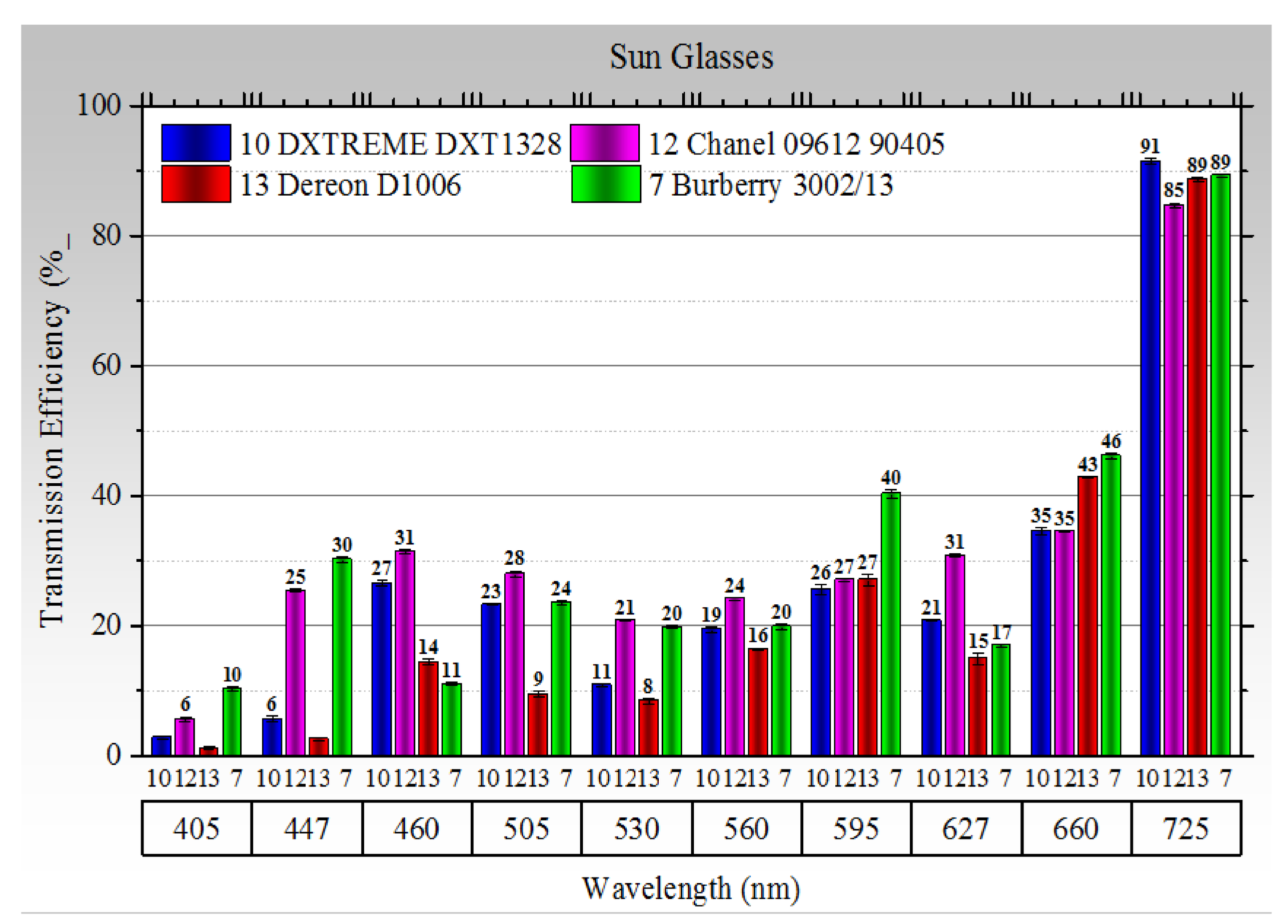

Fig 5. The transmission efficiencies of brand name sunglasses under each high-illuminant LED assemblies.

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