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Light-Emitting Diode Lights: The Future of Plant Lighting©

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INTRODUCTION

Higher plants require light for growth. Sunlight, or solar radiation, arriving at the earth's surface is electromagnetic radiation energy given off by the sun, and filtered through the earth's atmosphere. It comprises visible light, as well as near infrared radiant heat and short wavelength ultraviolet (UV) radiation. The spectral characteristics of the sun coupled with selective absorption of different wavelengths in the atmosphere means there are unequal amounts of each wavelength reaching the earth's surface. Light is characterised by its quality (i.e., wavelength) and its intensity.

The human eye is sensitive to visible light (i.e., what we see) in the spectrum of wavelengths from 380 nm (blue light) to 760 nm (red light) but is most sensitive to light in the green and yellow regions, peaking at 555 nm (Fig. 1). Plants perceive light differently from humans, wherein they use both visible and nonvisible solar radiation. Plants use photoreceptors to sense changes in light intensity, quality

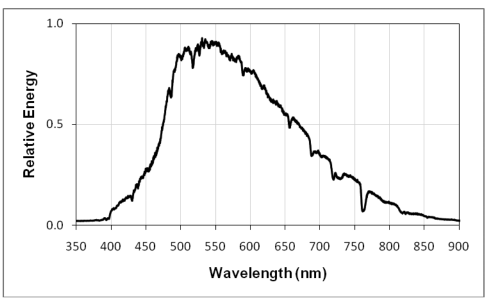

Figure 1. Spectral distribution of sunlight in the 350–900 nm range, which includes emissions in the nonvisble near infared region (>750 nm).

(wavelength), duration, and direction. They adapt their growth and development according to the light sensed. For instance, chlorophyll is a photoreceptor capturing the energy in light to convert carbon dioxide (CO_2) and water into carbohydrates through photosynthesis. Carbohydrates are the building blocks for the amino acids, proteins, fats, and vitamins required by living organisms. Carbohydrates with oxygen are necessary for plant and animal respiration, with CO_2 and water produced as by-products. Other photoreceptors control plant photomorphogenesis, shading resulting in etiolation or lengthening of internodes.

Understanding the spectral distribution characteristics of artificial light sources enables growers to match lamps to a desired plant response. To be commercially useful, plant lights need to be efficient converters of electrical energy to the wave-