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Annex B Photon Flux (Informative)

Visible light is typically defined in terms of either lumens (luminous flux) or watts (radiant flux). Horticulturalists, however, measure electromagnetic radiation over the range of 280 nm to 800 nm in terms of photons per second.

Each photon has a “quantum” of energy that is inversely proportional to its wavelength. Thus, the number of photons per second can be expressed in watts if you know the wavelength of each photon (or, more practically, all the photons that have the same wavelength).

Plant photosynthesis, however, depends on a chlorophyll molecule absorbing a single photon, regardless of its wavelength between, approximately 400 nm and 700 nm. Thus, horticulturalists are not concerned with the photon’s energy. They instead measure “photon flux” in terms of micromoles (6.022×10^{17}) photons per second. If the wavelength range is 400 nm to 700 nm, this is Photosynthetically Active Radiation (PAR).

Plants also respond to ultraviolet radiation (280 nm to 400 nm) and “far-red” radiation (700 nm to 800 nm). Depending on the application, horticultural measurements may be reported in terms of radiant flux or photon flux.

A comprehensive list of horticultural lighting metrics is provided in ANSI/ASABE S640 JUL2017, Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms).