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# The power of plants for good indoor air



**By Ronald Wood, Innovative Plant Technology**

**11 February 2011 – The new glazing standards in Section J of the Building Code are based on energy savings and not on the health and wellbeing of building occupants. But we can do both, with a better understanding of plants, according to Ronald Wood who is dedicated to spreading a fascinating message on the power of plants to create a better indoor air quality for people.**

One of the most cost-effective means of achieving points towards Green Star – Office interiors v1.1 Indoor Environmental Quality IEQ 15 is the installation of Indoor plants, such as atrium plantings as a permanent installation, or as free standing container plants.

Two points are available and easily achieved with a low technology application of suitable species selection, a minimum density requirement per work setting, and a two year horticultural maintenance plan in place to ensure long term plant health.

A competent interior plantscape company can usually meet these conditions. However, here's where serious complications arise.

Firstly, there is a lack of knowledge of correct plant light requirements in the commercial building sector. Current lighting "standards" are based on task performance and energy use, so little or no consideration is given to this aspect during lighting design.

There is also a general misunderstanding by architects, landscape architects, interior plantscapers and even lighting designers and engineers that the measurement of available plant light can be made using a lux meter.

A frequently asked question is whether 1200 lux is sufficient light for an atrium planting in a city building.

Visible light, as seen by the human eye, is measured in lux units. The lux is carefully defined to include only the wavelengths seen by our eyes. We use light for vision while plants use light for energy. The difficulty with light levels measured in lux is that light meters commonly used measure the wavelengths perceived by the human eye, but not the wavelengths needed for plant growth. Thus, lux is of little use in plant physiology, and hence plant health.

The Right Light? The only accurate assessment of available plant light is measurement with a quantum sensor, which registers photosynthetically active radiation. This is essentially a snapshot of plant light at that particular time, and there are many other factors to evaluate.

**People and plants both need "blue" light**

We now have a better understanding of the effects of light on the health and wellbeing of building occupants. Lighting design in North America and Europe is being extended beyond the normal parameters.

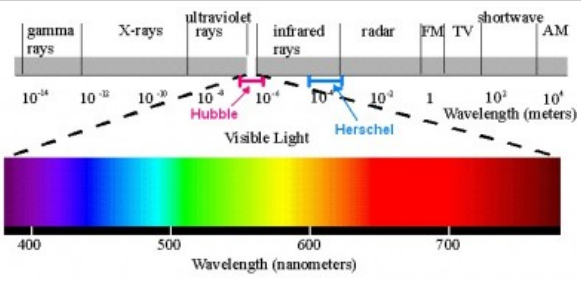


Figure 1. Action spectrum of electromagnetic radiation. Note the relatively narrow waveband between 380 nm and 780 nm for visible light. (Philips Lighting Artificial Lighting in Horticulture)

This stems from recent research that compares the effects of health, wellbeing and alertness of people working under different lighting conditions and shows that the biological effect of light is not directly stimulated by the illuminance on the working plane, but by light entering the eye. In other words light needs to enter the eye directly.

There are also photoreceptors in the eye (in addition to the rods and cones)that control the production of the hormones melatonin and cortisol. While melatonin makes us sleepy and relaxed, cortisol makes us feel awake, alert and alive.

The peak sensitivity for the visual system or photopic vision, which stimulates the production of either melatonin or cortisol, occurs at 550 nanometres (or the green light part of the light spectrum) while the peak sensitivity of the circadian system is at the short wavelength region of the spectrum at 420 – 480 nm, that is blue light, which is also essential for healthy plant growth.

**Figure 2. Action Spectra of Circadian and Photopic Light**

The curve Circadian Response , which regulates the biological system, is firmly in the blue part of the spectrum, which is also essential for stimulating chlorophyll production, encouraging strong stems and leaves and compact vegetative growth. So both people and plants need blue light.

Good atrium design will maximise the natural environment to minimise energy consumption.

The overlapping of the light spectrum for people and plants is a compelling reason why appropriate design consideration should be given to provide the “right” light for people and plants, with little, if any, additional cost implications.

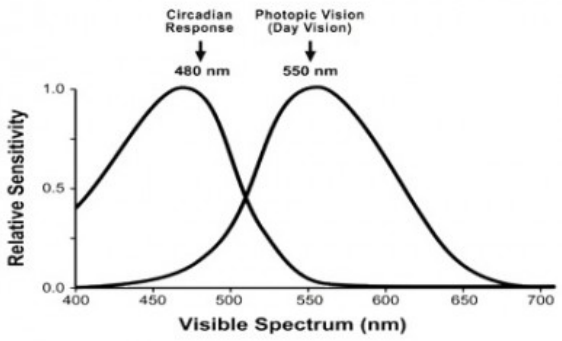


Figure 2. Action Spectra of Circadian and Photopic Light

**How much light do indoor plants need?**
The lighting requirements and the ways in which those requirements are fulfilled are related to a number of factors, including:

- Plant type(s) – species
- Level of acclimatisation
- Canopy size and shape
- Client expectations and design intent relating to plant characteristics such as canopy density, growth habit, life span and appearance.
- Light source(s)
- Direction of light
- Intensity and duration
- Light quality
- Interior design, architectural and engineering requirements.

For each plant species there is an optimum light intensity. Too much light intensity is seldom a problem in indoor landscape settings, however if light intensity is too low, the plant will have weak growth and gradually deteriorate.
A clear understanding of these factors enables the correct lighting solutions to be developed to achieve healthy, thriving interior landscapes.

**Total Available Light**
Natural light entering an interior space through a glazing system consists of three types of light:

- Sunlight, the direct rays of the sun
- Daylight (skylight), indirect light
- Reflected light, which can be either direct sunlight or daylight reflected off exterior or interior surfaces before or after it passes through the glazing.

The combination of direct sunlight, skylight, and reflected light is the total available light. Atrium design can be used to reduce the need for supplementary lighting, with potential cost savings. An atrium designed to reflect, direct, or diffuse sunlight, can be one of the most pleasing means of controlling light.

As the amount of time a plant can receive direct sunlight is limited by the size and orientation of the glazing, in most cases plants obtain a majority of their light energy from daylight. This is further influenced by the percentage of light transmittance and the proximity of the plants to the glazing. Diffuse (or ambient) light is separate from direct sunlight and is an important component of the total available light for plant photosynthesis. The amount of diffuse light available is often the key to successful atrium plantings.

**Glazing Systems**
There is currently no commercial glazing system which meets all of the plant light requirements while minimising solar heat gain. However Iit is essential that the glazing system allows passage of wavelengths in the range 400 nmto 700 nm. Reflective and tinted glass, in addition to reducing the

intensity of light, also can alter the spectral energy of light passing through, usually to the detriment of the plants.
Changes in May 2010 to BCA 2010, Section J, the Australian Building Codes Board require a careful evaluation of glazing characteristics to achieve sufficient light quality and quantity to ensure long term plant health.

To achieve Green Star rating points for IEQ 15, by the Green Building Council of Australia, a balance between choice of glazing for daylight and solar heat load, together if necessary, with correct supplementary lighting is essential for healthy thriving plants.

**Supplementary Lighting**
It may be necessary to consider supplementary lighting to balance uneven light distribution within the landscaped space for the following reasons:

- Plants need 12-16 hours of light followed by a period of darkness to maintain normal physiological responses.
- The building design may give highly directional lighting. Plants have evolved with a moving light source, which has an effect on the form and shapes of the plant canopy.
- Uneven lighting will disrupt a uniform development pattern, subjecting plants to stress.
- Supplementary natural light through side windows may be drastically reduced through poor transmission, particularly tinted glass for glare reduction.

The choice of a lamp(s) for a particular plant lighting installation is dependent on the intended outcome:

- Daylight extension
- Daylight replacement
- Supplementary lighting for additional growth

Light is the major determining factor in successfully maintaining healthy plants indoors. Incorrect lighting can result in interior landscape projects achieving limited success, or invariably failure, with possible negative impact on reputation and economic consequences.

When the light requirements are not met, the design concept of bringing nature indoors to create a healthy workspace will not be achieved. For this reason it is crucial before installation to Identify the available daylight, daily light integral, and spectral characteristics of the glazing, for selection of appropriate plant species. Meeting the correct light requirements allows planning for success.

Lighting for good plant health and human health indoors requires a careful evaluation of all of the factors. Getting it right secures two easy points, and a more healthful and productive environment.

*Dr Ronald Wood is director of Innovative Plant Technology Pty Ltd and has more than 30 years experience with all aspects of interior/exterior landscapes, in Australia, North America, Europe and Japan. He is an environmental scientist, acknowledged for pioneering research in the role of plants in the indoor environment for the reduction of air-borne volatile organic contaminants. He has advised on a number of major office buildings including the refurbishment of Grosvenor Place. Contact: iplant@plantscleanair.com*

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