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THE LIGHTING KNOWLEDGE COMPANY

HPS vs. LED
Which Technology is Best for Your Application?

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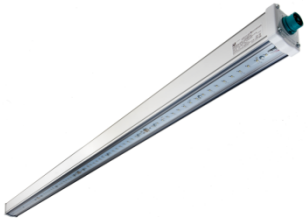
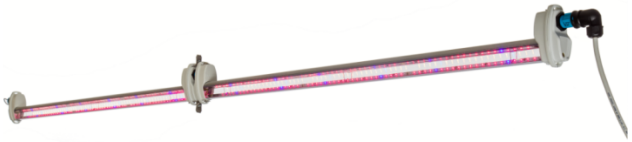
Current State of LEDs in Horticulture

Typical Applications: LEDs

General Top Lighting



Multi-Layer Propagation Lighting



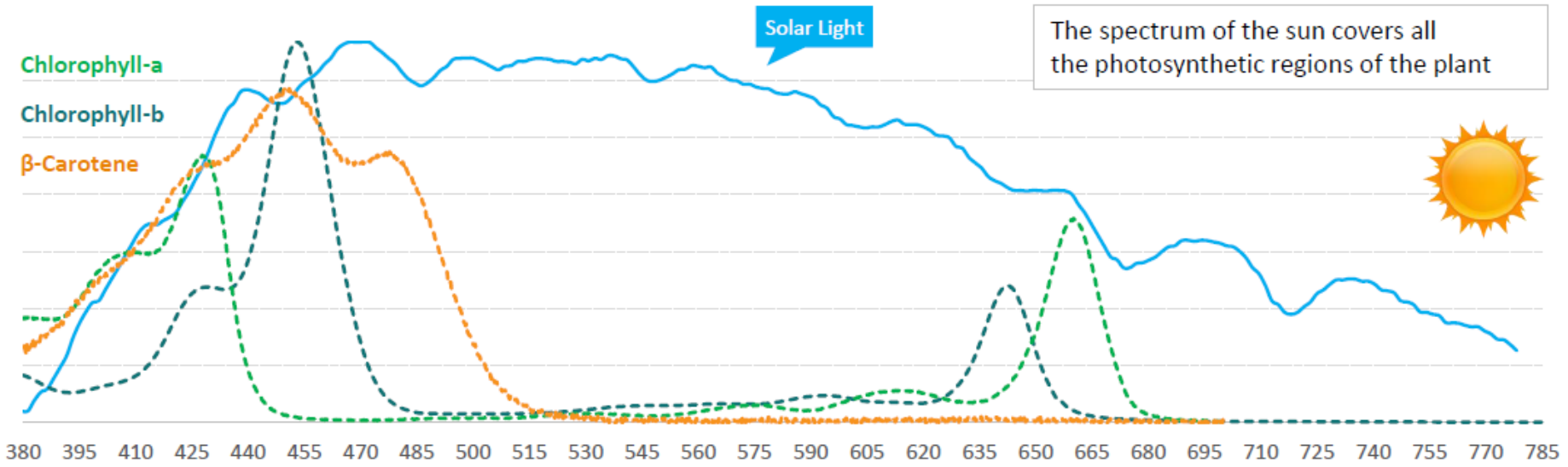
Inter Lighting

Growing without DAYLIGHT	Growing with DAYLIGHT
• Tissue culture • Seed germination • Young plant production • Vernilization of young plants • Production of leafy and micro greens • Research applications • Bulbous plants	• Lettuce, leafy and micro greens • Young plant production • Tree nurseries, rooting of cuttings • Bulbous plants • Cut flowers • Potted plants • High wire crops • Influencing morphogenic plant development (steering light)

Advantages of LEDs in Horticulture

- Energy Savings
- Optical Design Freedom
- Spectral Tuning
- Heat Management
- Long Life, Low Maintenance

Light & Morphology



Blue Light (400-499 nm)

- Inhibits stem elongation
- Important for chlorophyll synthesis
- Promotes greening of germinating seedlings

Green Light (500-599 nm)

- Most visually comfortable for human eye
- Best for visual assessment of plant health

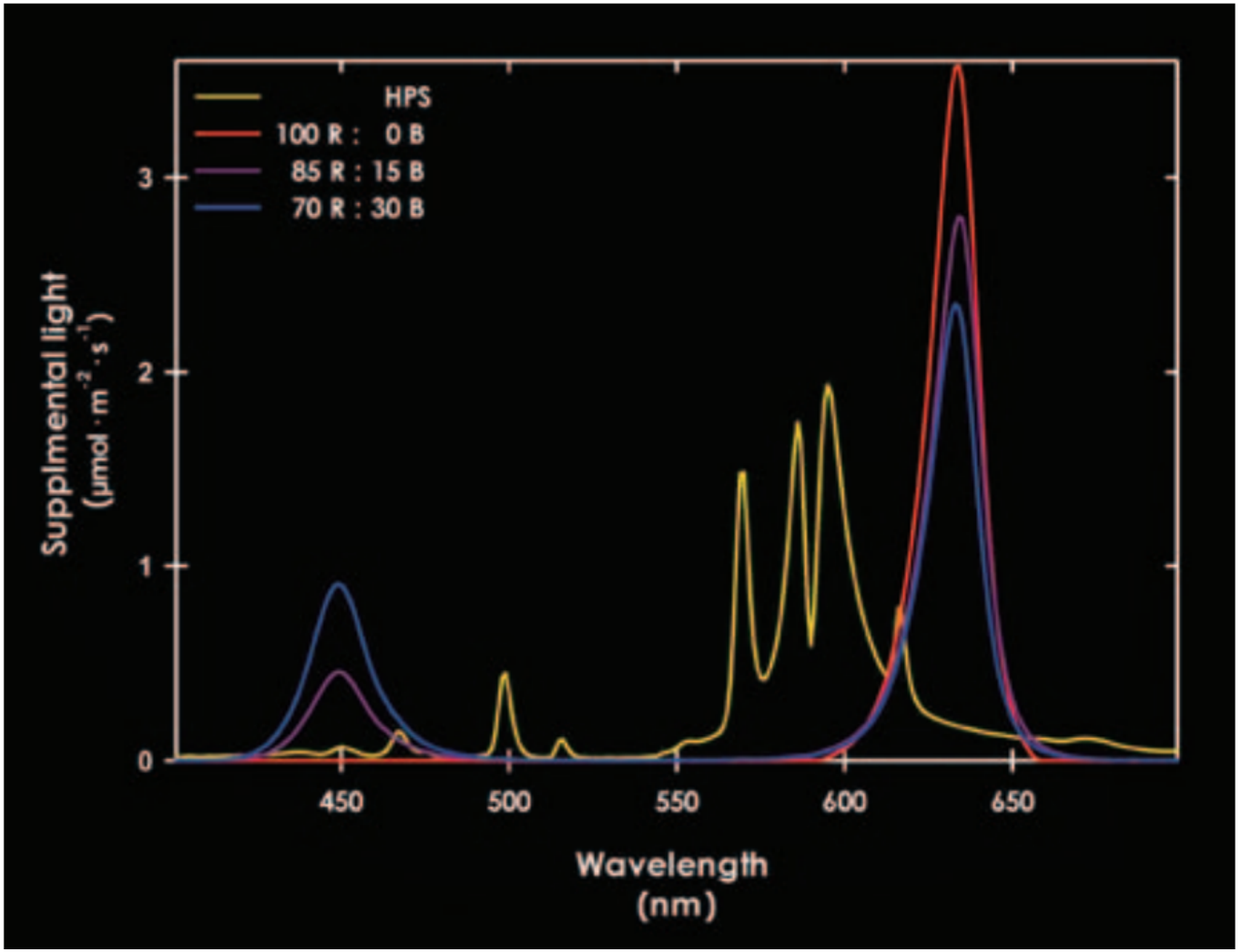
Red Light (600-700 nm)

- Speeds up seed germination
- Encourages stem growth
- Essential for flowering and fruit production
- Stimulates root growth

Far Red Light (701-750 nm)

- Promotes stem elongation
- Inhibits branching
- Thinner and bigger leaves with thinner cuticles

Colour Spectra Efficiency

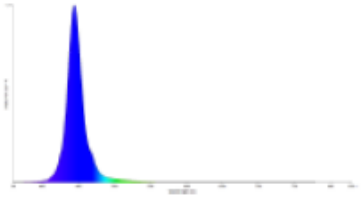


Spectral quality of 70µmol.m2.s1 delivered by HPS lamps or LEDs with % 100:0, 85:15, or 70:30 red:blue light.

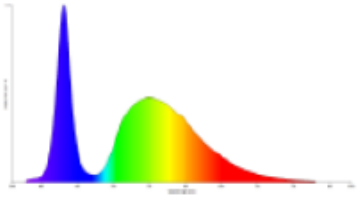
Image source: Purdue University

Colour Spectra Efficiency

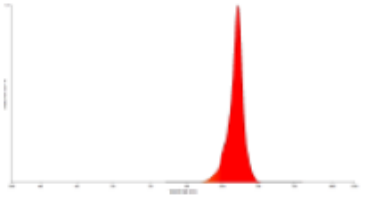
460nm deep blue 2,4 µmol/J



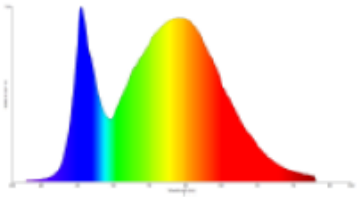
6500K cold white 2,0 µmol/J



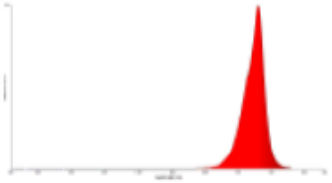
660nm hyper red 3,0 µmol/J



4000K neutral white 2,0 µmol/J

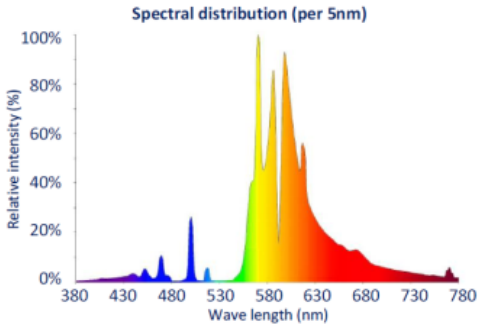


730nm farred 2,0 µmol/J



PL Light Systems'
LED Spectral Efficiencies

1000W DE HPS Lamp
Spectral Efficiency



HPS 1.88µmol/J

Spectral Tuning

- Growers can use spectral tuning to manipulate desired responses
- To encourage more compact growth, with sturdier leaves, use a higher component of blue light
- If the intent is to encourage flowering, use less blue light and more red light
- Leaf pigment can be manipulated by using specific wavelengths

LED Trial – University of Guelph

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The Case for HPS

Disdvantages of LEDs in Horticulture

- High capital expenditure + other related incremental costs
- Lack of Quality Standards
- Optimal light recipes for specific crops & varietals still largely unproven

Cost of Ownership: LED vs. HPS

1000w HPS DE Fixture w/ 2100 umol output at $550 = $0.26/µmol

215w LED Top Light w/ 550 umol output at $420 = $1.31/µmol
320w LED Top Light w/ 860 umol output at $950 = $1.10/µmol

LED Toplight is currently 4-5X cost of HPS

Where to Next for LEDs in Horticulture

- Establish Industry Standards
- Define Optimal Light Recipes for optimal plant growth, fruit yield and quality for specific crops and varietals.
- Cost efficiencies to reduce capital costs

LED Lighting: Factors to Consider

Longevity

Thermal management is essential for maximizing light output, reliability and lifetime of an LED fixture.

Optimized Performance

Look for fixtures that are engineered specifically for horticultural applications.

Guaranteed Quality

Look out for exaggerated claims.

Return on Investment

Payback calculations for LED lighting are only useful when they apply specifically to your situation.

Cost

Do your homework. The cheapest price may turn out to be an expensive mistake.

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Thank you