

# LED Lighting For Horticulture Applications

Presented by: Shenali Parikh

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## TODAY'S AGENDA

### Topics:

- Overview
- Benefits of LED
- Lumens vs. PAR
- Key Metrics
- Determining What You Need for Your Job
- Horticulture Lighting
  - The Science Behind It
  - Applications
  - T8 Lamp

**MaxLite** Webinars  
A NEW WAVE OF LIGHT

MaxLite Presents:

### LED Lighting For Horticulture Applications

**Wednesday, 12/21/16 @ 12pm EST**

Join us for an educational webinar explaining the science behind horticulture lighting and why LEDs are an excellent choice for indoor growers of flowers, vegetables and cannabis.

MaxLite's new line of LED horticulture lights are specifically engineered to reduce energy usage for this burgeoning market.

**PhotonMax Horticulture T8 Lamps Features:**

- Self-ballasted and easy to install
- Peak wavelength at 450nm (royal blue) and 650nm (deep red) to promote flowering
- Glass-free design eliminates breakage concerns





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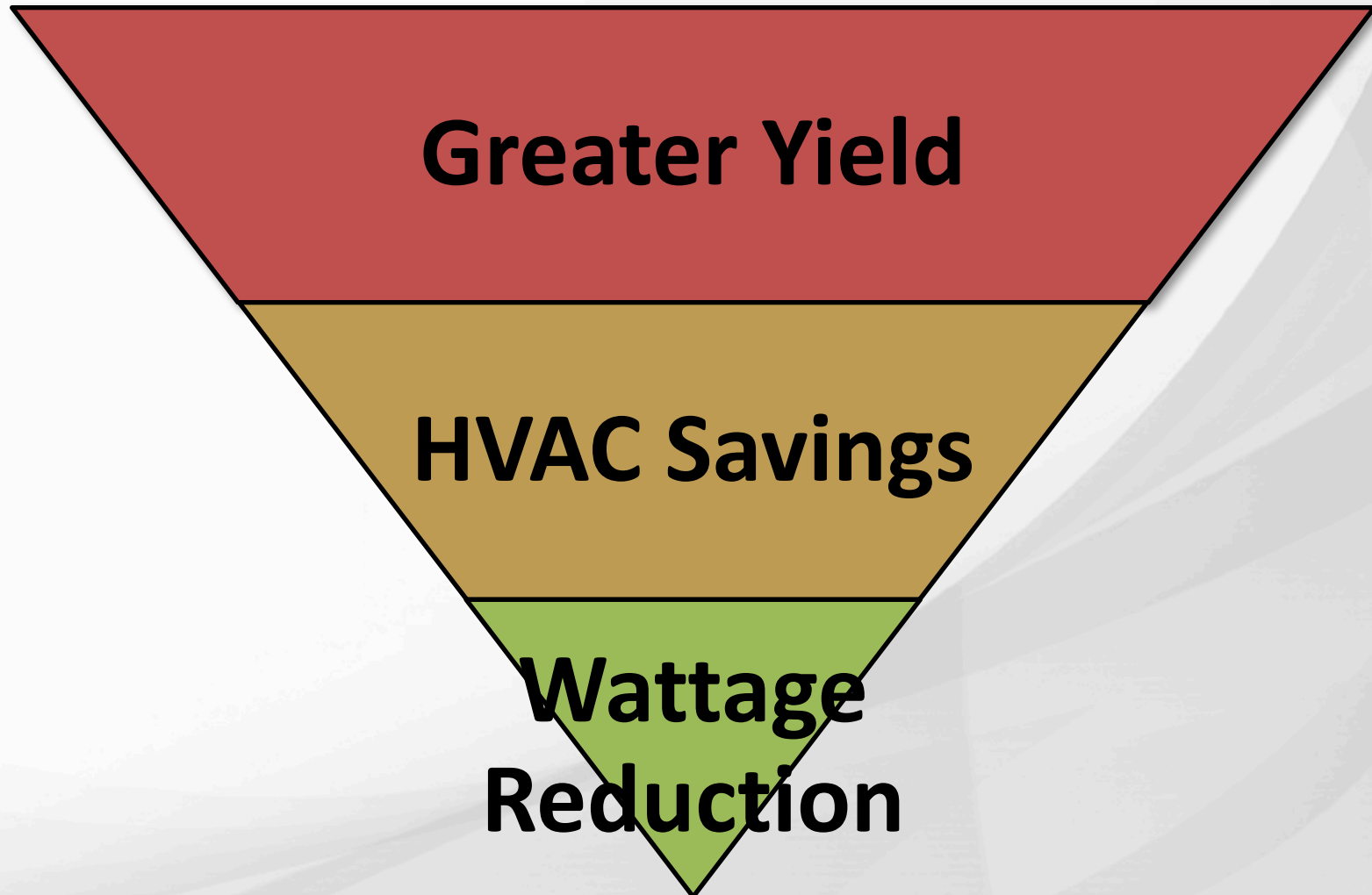




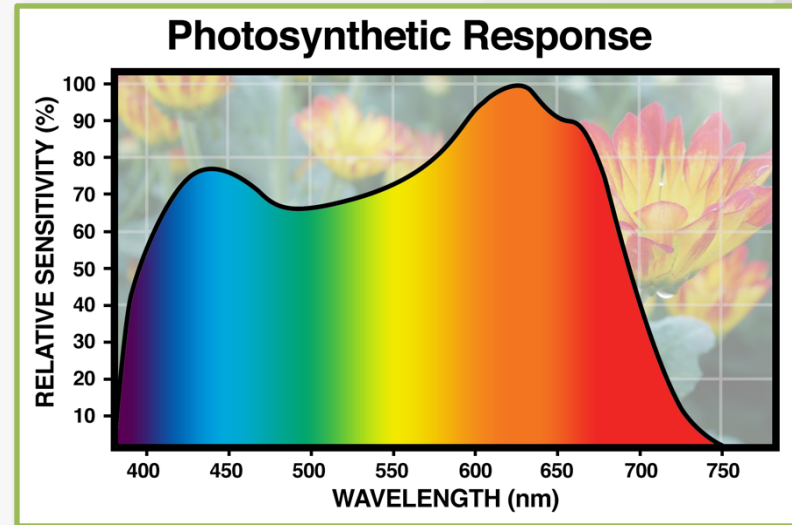
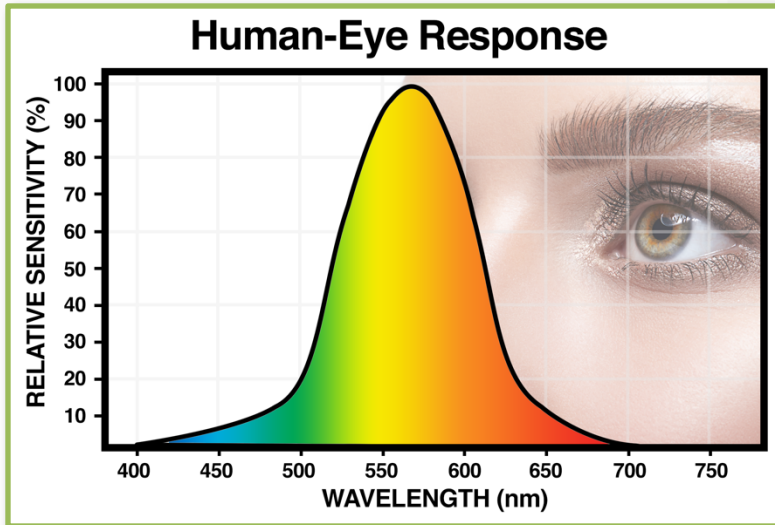

# HORTICULTURE LIGHTING

- **What is Horticulture Lighting?**
  - Horticulture relates to the art, science and technology of growing agriculture
  - LED Lighting is used to supplement/substitute natural sunlight to grow plants
- **What is the LED horticulture market size and where are the opportunities for growth?**
  - By 2020, growth is expected to be almost \$2 billion at a CAGR of 26.93%
  - Used for more applications as LED light makes it possible for efficiently growing plants, conserving space and improving yields
- **How is LED horticulture lighting different from “normal” LED lighting?**
  - With horticulture lighting, the main concern is how much usable light is reaching the plant.
  - The three key metrics for horticulture lighting are photosynthetic photon flux (PPF), photosynthetic photon flux density (PPFD), and photon efficiency.

## BENEFITS OF LED LIGHTING



# LUMENS VS. PAR



- **Photopic Response Curve**

- Lumens
  - Unit of measurement based on human eye's sensitivity in well-lit conditions.

- **Photosynthetic Response Curve**

- Photosynthetic Active Radiation (PAR)
  - Plants "see" more light than humans. Light within the 400nm to 700nm range is used by a plant to support photosynthesis.

## KEY METRICS

### Photosynthetic Photon Flux (PPF)

- How much PAR does a fixture produce?
- Measures total amount of light produced each second
- Measured in  $\mu\text{mol/s}$

### Photosynthetic Photon Flux Density (PPFD)

- How much of the PAR is available to plants?
- Measures how much of the active photons fall on a given surface of the plant.
- PPFD changes with coverage area and height.
- Measured in  $\mu\text{mol/s/m}^2$

### Photon Efficiency

- How much energy does the fixture need to deliver PAR to plants?
- Measures how efficiently a fixture converts electrical energy into usable PAR photons.
- Measured in  $\mu\text{mol/J}$

### Coverage Area

- At a given mounting height, what area of the plant bed is covered?
- As mounting height changes, coverage area and PPFD will change.
- Measured in  $\text{m}^2$

# COMPARING APPLES TO ORANGES

- Don't compare wattages
- Don't compare lumens
- There's no known ideal growth spectrum
- Understand how PAR and PPFD vary over coverage areas
- Different form factors are effective for different applications
- Keep in mind the main objective in horticulture lighting:
  - **Does the yield increase?**



## LED HORTICULTURE LIGHTING

# LED Lighting

Blue  
Wavelength  
(450-495 nm)

Heavy blue  
light promotes  
vegetation

Red  
Wavelength  
(620-700 nm)

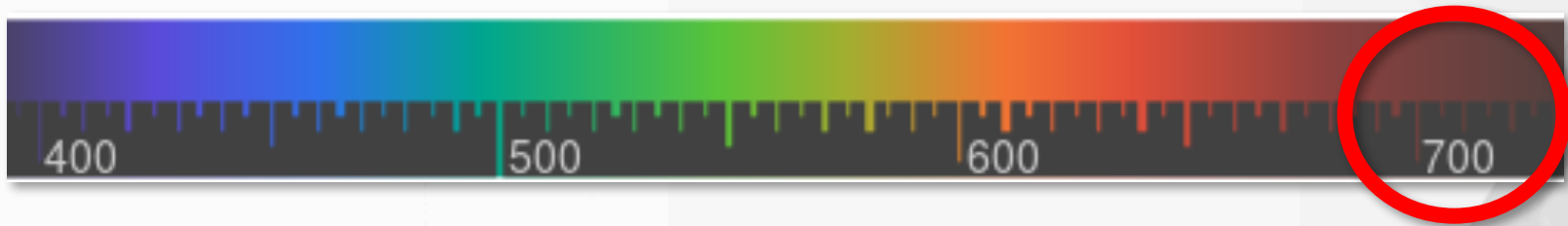
Heavy red light  
promotes  
flowering

Far Red  
Wavelength  
(700-750 nm)

Far red light  
promotes  
Emerson Effect



# EMERSON EFFECT



## Use red light only (660 nm)

- Ideal for flowering
- Mimics direct sun light

## Use red light (660 nm) + far red light (730 nm)

- Accelerates stem growth
- Mimics shade

## APPLICATIONS

### Substitution

- Indoor grow areas
- No sunlight

### Supplemental

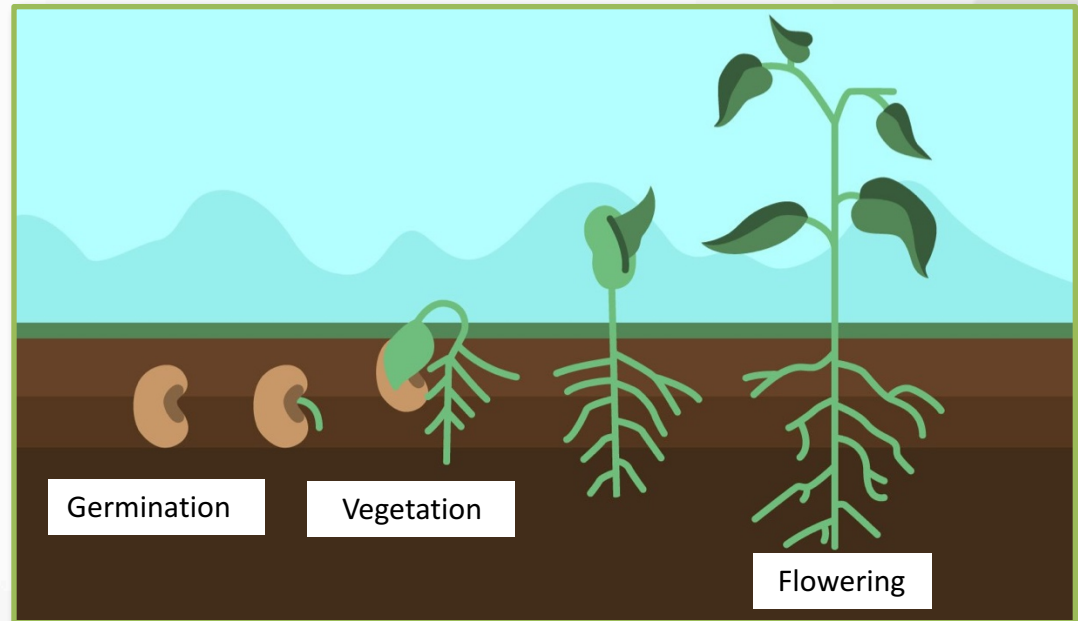
- Greenhouses
- Supplements natural daylight
- Use LED to raise grow levels and yields

### Photoperiodic

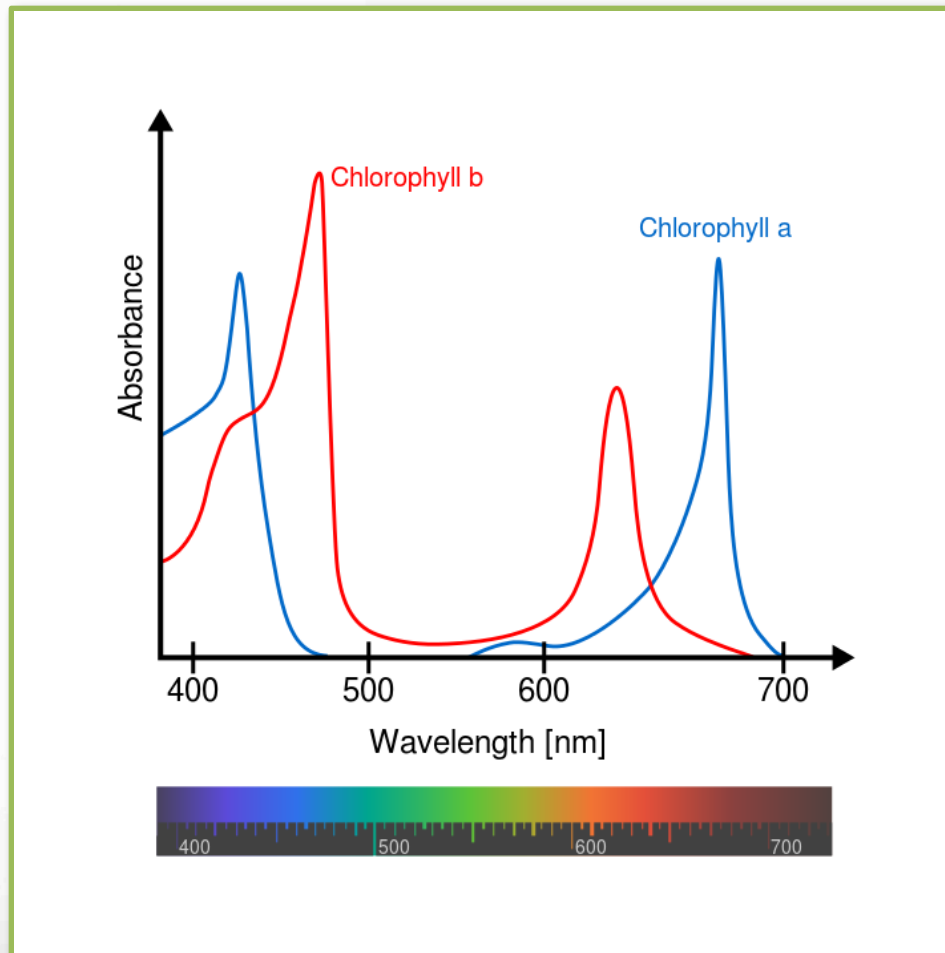
- Greenhouses or outdoor farming
- Artificially extend natural day length

# THE SCIENCE BEHIND IT

- **Photosynthesis**
  - Process by which plants convert CO<sub>2</sub> into carbohydrates for nutrients
- **Spectral Composition**
  - Different wavelengths affect different areas of the growth cycle
- **Photoperiod**
  - The length of day and night required for initiation of flowering



# ABSORPTION OF LIGHT



By Chlorophyll\_ab\_spectra2.PNG: Daniele Pugliese derivative work: M0tty - This file was derived from Chlorophyll ab spectra2.PNG; CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=20509583>

# APPLICATIONS: AISLE FARMING

## ● Toplighting

- Fixtures are hung higher to mimic sunlight during darker hours
- Significant reduction in heat production
- Allows for lower mounting heights and more coverage

## ● Product Type

- Wide distribution to cover large areas
- High power product to penetrate tall canopies
- Minimization of hotspots
- Minimization of light “lost” to aisles and walls



# APPLICATIONS: GREENHOUSES

## ● Interlighting

- To prevent the “shadowing” effects of toplighting, LEDs can be placed between the plants and the leaves to better distribute light.

## ● Toplighting

## ● Product Type

- Wide distribution to cover large areas
- Slim product to avoid shadows
- High power product to penetrate tall canopies



# APPLICATIONS: VERTICAL FARMING

## ● Toplighting

- Fixtures are hung higher to mimic sunlight during darker hours
- Significant reduction in heat production
- Allows for lower mounting heights and more coverage

## ● Interlighting

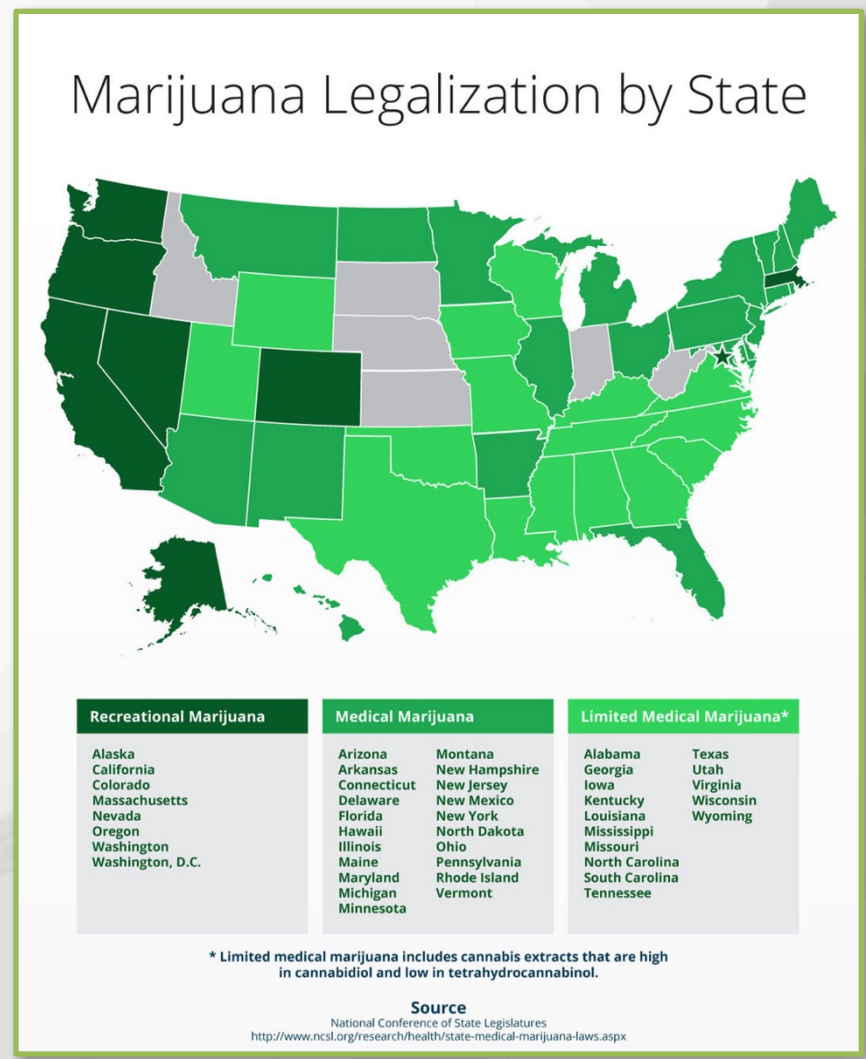
## ● Product Type

- Slim profile to cover smaller footprints
- Lower wattage needs



## APPLICATIONS: RESIDENTIAL FARMING

- Marijuana legalization continues to spread across the country
- Increase in residential grower market
- **Product Type**
  - T8 and T5 horticulture tubes
  - Small, low wattage “low bays”
  - Canopy penetration and PPF not key factors





## FUTURE OUTLOOK

- **In 2015 in Denver, Colorado, Bloomberg reported:**
  - 1200 licensed grow facilities
  - Contributed to half of state's new power demands (equivalent to 35,000 households)
- **Studies Show:**
  - Legal indoor marijuana grow facilities accounted for 1% of national electricity use at cost of \$6 billion per year

- **Future**
  - Rebates will continue to increase across the national
  - Almost all programs offer customized rebates for agriculture applications

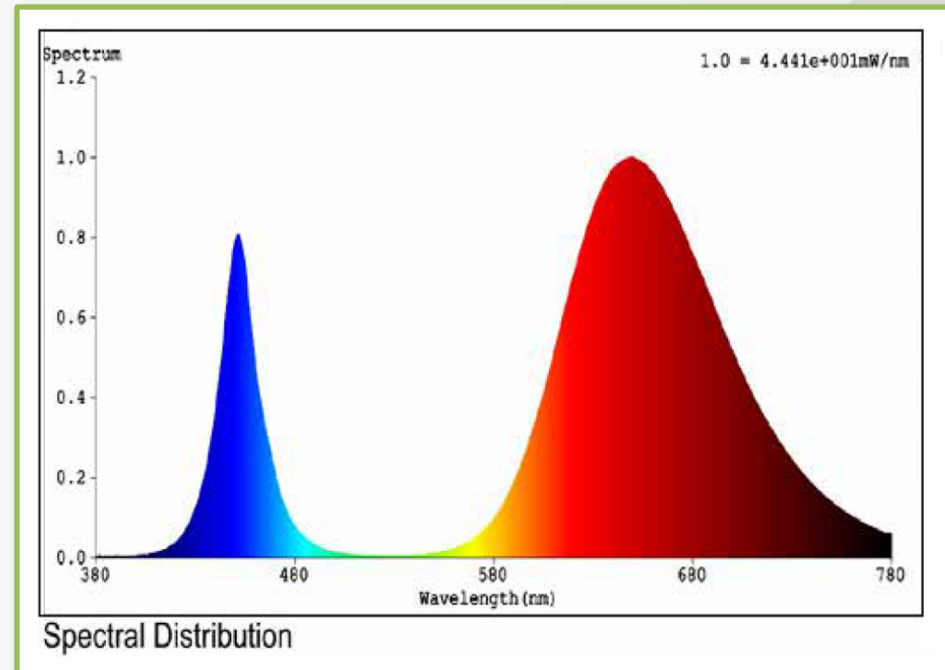


# LED HORTICULTURE – T8 LAMP



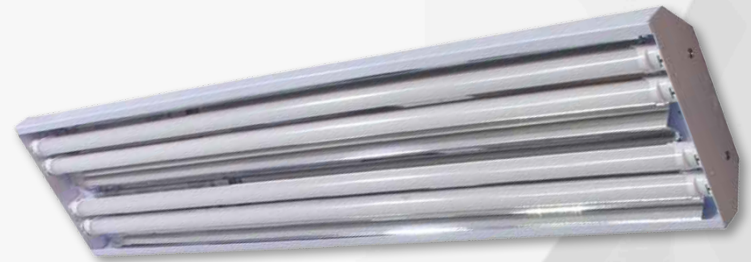
## ● Features

- L18T8SE415
- Single-ended (self-ballasted)
- Nominal Wattage: 18W
- Length = 4 FT
- Glass-free design



Peak wavelengths at 450nm (royal blue) and 650nm (deep red) to promote FLOWERING

## A TOTAL SOLUTION!



**COMPLETE  
SOLUTION**

## QUESTIONS/ANSWERS

Thank you everyone for your attention! Please feel free to use this opportunity to ask any questions you may have about MaxLite or the products shown in this presentation.

FOR MORE INFORMATION ABOUT OTHER MAXLITE PRODUCTS, OR FOR LIGHTING QUESTIONS IN GENERAL; PLEASE CONTACT:

[info@maxlite.com](mailto:info@maxlite.com)

<http://www.maxlite.com>

1-800-555-5629