GrowFilm™ Field Trial

April 2017
GrowFilm Characteristics

• Spectra – GrowFilm spectra has been designed with plant photosynthesis in mind
  – GrowFilm’s spectra can be customized to meet any growing need

• Uniformity – GrowFilm, with its “many points of light”, provides the best uniformity over all other types of lights
  – Increases yield over entire growing area

• Intensity, DLI, and Energy Consumption can be adjusted to achieve any specific requirements
  – Efficacy of lighting is maximized resulting in increased yields and lower costs

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• During the month of April 2017, a trial grow was conducted with a long-term, sophisticated indoor grower.
  – They have been operating a very sophisticated CEA for the past four years
  – They have advanced aeroponics technology to implement and measure all elements of indoor farming.
• Management wanted to test GrowFilm under actual growing conditions side-by-side with their existing lighting system which consisted of 400W induction lamps
• Prior to the field test, there was extensive lab testing of each lighting system to measure PPFD and light distribution at various heights above the lights.
  – Both the Patriot and White Lightning GrowFilm lamps were used in this trial to detect any differences in outcomes
• Questions that needed answers:
  – Would various plants grow as well or better using GrowFilm lamps measured both in appearance and wet weight?
  – Would it have any effect on the growing cycle?
  – Would there be a savings in energy costs - both in operating the lights and reduced A/C?
  – Could there be other advantages in using GrowFilm’s LED Lighting System?
Measurements Of Existing System

• Random measurements were taken at the canopy of the plants using new induction lamp fixtures with a Li-Cor PAR meter.
  – Values between 151 and 252 µmol/m²s were recorded
    • At canopy in front of fan – 112 µmol/m²s
    • At canopy on outer edges of plants – 23 µmol/m²s

• Power Usage
  – 4, 400W Induction lamps are used to cover an area of 64 ft² (two 4’x 8’ sections - front and back)
  – Actual power draw measured was 370W or 23.1W/ft²
PPFD Map of Induction Lamp 10" Above Canopy (µmol/m²s)

Area covered: 8 sq. ft.

0-100  100-200  200-300

Min: 24.5  Max: 274.9  Avg: 121.4  Max:Min: 11.2  Avg:Min: 4.9

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PPFD Map of Induction Lamp 2" Above Canopy (µmol/m²s)

Area covered: 8 sq. ft.

Min: 6.7
Max: 624.8
Avg: 151.4
Max:Min: 93.5
Avg:Min: 22.7

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Testing of GrowFilm System

• Uniformity comparison measurements
  – Set GrowFilm lamps to emit same PPFD as induction lamp at 10”.
  – 275 µmol/m²s.

• Power Usage
  – Above parameters set wattage of each GrowFilm lamp.
    • White Lightning was set to 14.2W/ft²
    • Patriot was set to 22.5W/ft²
Light Spectra of Both GrowFilm Lamps

Wavelength (nm) vs Relative Spectral Power and Relative Absorbance for White Lightning, Patriot, Chlorophyll A, Chlorophyll B

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PPFD Map of GrowFilm Patriot 10" Above Canopy (μmol/m²s)

Area covered: 8 ft²

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PPFD Map of GrowFilm Patriot 2" Above Canopy (µmol/m²s)

Area covered: 8 ft²

Min: 63.95
Max: 356.2
Avg: 230.3
Max:Min: 5.6
Avg:Min: 3.6

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PPFD Map of GrowFilm White Lightning 10" Above Canopy (µmol/m²s)

Area covered: 8 ft²

Min: 81.3
Max: 275.2
Avg: 184.6
Max:Min: 3.4
Avg:Min: 2.3

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PPFD Map of GrowFilm White Lightning 2" Above Canopy (µmol/m²s)

Area covered: 8 ft²

Min 71.5
Max 327.4
Avg 231.2
Max:Min 4.6
Avg:Min 3.2

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Setting GrowFilm Experiment Parameters

• Try variations of existing strategy
  • Idea 1 – Keep time of grow (9 hours/day) and PPFD (in µmol/m²s) the same
  • Idea 2 – Keep time of grow (9 hours/day) and power consumption the same
• Or - - Implement what we knew will work best
Scientific Data Needs To Drive Trial

• Strategy – Provide the best “grow” using scientific data that we know to be true

  – Dr. John Erwin, University of Minnesota, recommended a maximum DLI of 12 mols for vegetative growth
  – Lighting time for plants was set at 9 hours a day
  – Therefore, each GrowFilm variety (Patriot and White Lightning) were set to PPFD of 370 µmol/m²s which resulted in programing drivers to the following wattage:
    • Patriot – 24 W/ft²
    • White Lightning – 17.5 W/ft²
PPFD of 4 sheets of GrowFilm (8 ft²)

- Peak Output at 7" (µmol/m²-s)
- Power (W/ft²)
- White Lightning
- Patriot
- 370 umol/m²/s
Preliminary Results

• Plan
  – 28-day grow cycle
  – Plants put in system on April 7 – Arugula, Asian Greens, Bibb, Red Oak, Green Oak, Upland Cress
  – Weigh test scheduled for May 4th

• Actual
  – Arugula and Asian Greens harvested on Day 17
  – Weigh test was conducted on April 24th
Wet Weight Data Comparisons

• Arugula
  – Induction Lights
    • Gross Weight – 56.33 oz.
      – Average of 4 boards
  – WL GrowFilm
    • Gross Weight – 71.40 oz.
      – Percent Increase = 27%
  – Patriot GrowFilm
    • Gross weight – 83.25 oz.
      – Percent Increase = 48%
Better and Faster

Plants grown under GrowFilm (at end of row) grew out further and faster than using inductive lighting.

Harvested in 17 days versus 28 (39% decrease).
Asian Greens After 11 Days

Bigger leaves sooner under Patriot GrowFilm
Red Oak After 11 Days

Tight head, deep purple color under Patriot GrowFilm
Green Oak After 11 Days

Tighter Head and Better Looking Product

Tight head under Patriot GrowFilm

Loose head under Induction light

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Preliminary Conclusions

• Increased wet weight by 27% (WL) and 48% (Patriot) for Arugula.
• Reduced grow time from 28 days to 17 (reduced by 39%) for Arugula and Asian Greens.
• Reduced energy usage by TBD.
  – Tests are under way to quantify savings which could be significant.
• Other findings
  – Uniformity of plants across entire grow area improved.
  – Visual look and desired shape of plants improved.
  – Since GrowFilm can be placed closer to plants, grower concluded they could grow 10% more product in same amount of floor space.
Come Grow With Us

For More Information
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