LED and Fluorescent Lighting Effects on Hydroponically Grown ‘Tom Thumb’ Lettuce

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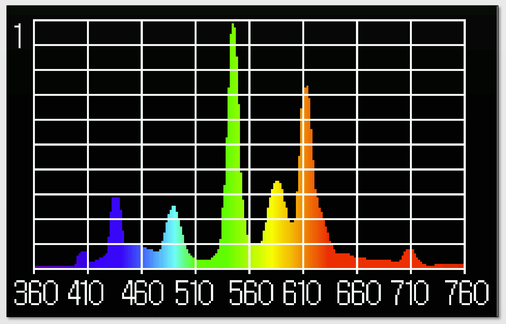
Introduction



There is growing concern about food safety, environmental impact, and efficient energy usage in horticultural production systems. Producing lettuce under artificial lighting could be a solution addressing these concerns.

Objective: Determine the effects of light-emitting diodes (LEDs) and fluorescent lighting and the sequence of lighting on the growth of ‘Tom Thumb’ lettuce in a noncirculating hydroponic system.

Methods

- Lettuce seeds were started in Oasis cubes. Seedlings were transferred to 5.1-cm net pots in 1.9-L containers containing a hydroponic nutrient solution.
- Solution was Hydro-Gardens' Chem-Gro lettuce formula 8-15-36 hydroponic fertilizer, calcium nitrate (19% Ca and 15.5% N), and magnesium sulfate (9.8% Mg and 12.9% SO_4).
- Half of the seedlings were grown under red+blue+white LEDs, 110 µmol/m^2/s, and half under T5 high output fluorescent lighting, 111 µmol/m^2/s. Photoperiod was 12 h.
- After 12 days, half of the plants under LEDs were moved under fluorescent lighting, and half of the plants under fluorescent lighting were moved under LEDS for 16 more days.

Methods

Fig. 1. T5 high output fluorescent lighting setup.

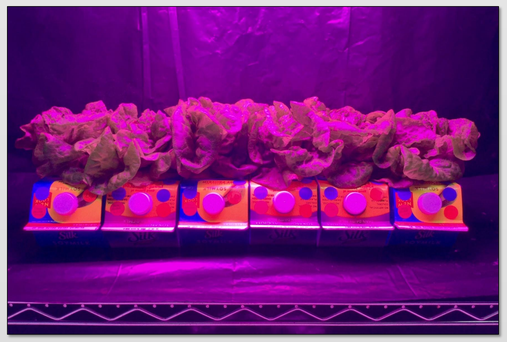


Fig. 2. Light-emitting diode (LEDs) lighting setup.

Results

Table 1. Lettuce height and dry weight (DW).

Treatment	Plant height (cm)	Shoot dry weight (DW) (g)	Root DW (g)	Total plant DW (g)
LEDs	10.4 b	3.4 ns	0.41 a	3.8 a
LEDs, then fluorescent	13.1 a	2.3	0.25 b	2.5 bc
Fluorescent	12.4 ab	2.1	0.24 b	2.4 c
Fluorescent, then LEDs	10.4 b	3.0	0.44 a	3.5 ab

Results

Table 2. Lettuce DW partitioning and SPAD reading.

Treatment	Shoot DW partitioning (%)	Root DW partitioning (%)	Shoot-root ratio	SPAD reading
LEDs	88.9 ns	11.1 ns	8.3 ns	18.1 a
LEDs, then fluorescent	90.0	10.0	9.0	17.4 a
Fluorescent	89.8	10.2	9.0	17.4 a
Fluorescent, then LEDs	87.4	12.6	7.0	13.7 b

Table 3. Lettuce hydroponic nutrient solution.

Treatment	Shoot DW /nutrient solution used (mg/mL)	Nutrient solution used (mL)	EC (mS/cm)	pH
LEDs	7.8 a	433 ns	2.6 c	7.2 a
LEDs, then fluorescent	4.1 bc	567	3.5 b	6.9 b
Fluorescent	3.3 c	643	4.0 a	6.9 b
Fluorescent, then LEDs	5.2 b	578	3.0 c	7.2 a

Conclusions

The sequence of LED and fluorescent lighting could be an alternative to only LED or fluorescent lighting for lettuce.

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