



Green cucumbers in the red: Higher yield under white than primarily red spectrum

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Background and aim

Supplemental greenhouse lighting is usually by HPS lamps, however, red LEDs with a small fraction of blue are becoming more popular. White LEDs are less energy efficient, however, they are more ergonomic to work in. We determined whether broadband white LEDs can achieve similar cucumber yields and quality as narrow-band red/white LED.



Figure 1. Cucumber plants under narrow-band red/white LED (left, cv. 'Proloog') and broadband white LED (right, cv. 'Hi Power') two weeks after transplanting.

Materials & Methods

Light recipes: (1) Narrow-band red/white LED and (2) broadband White LED

Light conditions: 16 h photoperiod | 280 $\mu\text{mol}/\text{m}^2/\text{s}$

Cultivars: 'Hi Power' and 'Proloog'

Duration: Four months in high-wire Venlo greenhouse

Results

For broadband white LED:

- Fruit fresh yield about 13% higher for both cultivars
- Fruit dry weight about 15% higher for both cultivars
- Number of harvested fruits 7% higher.

For narrow-band red/white LED:

- Internode length 20% higher.
- Specific leaf area 17-21% higher.



Figure 2. Cucumber plants of cv. 'Proloog' grown under broadband white LED two weeks after transplanting.

Table 1. Cucumber yield and internode length after 15 weeks of cultivation. Means followed by a different letter within a cultivar are significantly different according to one-way ANOVA F-test ($P=0.05$).

Cultivar	Treatment	Internode length (cm)	Fruit FW (kg/m^2)	No. of fruits per m^2	TDW (kg/m^2)
Hi Power	Red/white	9.5 b	48.5 a	122 a	2.1 a
	White	8.1 a	55.4 a	132 a	2.4 a
Proloog	Red/white	9.8 b	48.9 a	116 a	2.0 a
	White	8.2 a	55.5 b	123 b	2.4 b

Results – Fruit quality

- Supplementary broadband white LED resulted in a higher Brix compared to narrow-band red/white LED.
- No difference in pH of the fruit juice between the two light treatments for either cultivar, with all pH values between 6.1 and 6.4.



Figure 3. Cucumber plants of cv. 'Proloog' grown under narrow-band red/white LED two weeks after transplanting.

Table 2. Average cucumber fruit quality after 13 weeks of cultivation. Means followed by a different letter within a cultivar are significantly different according to one-way ANOVA F-test ($P=0.05$).

Cultivar	Treatment	Fruit FW (g)	DMC (%)	Brix ($^{\circ}\text{Bx}$)
Hi Power	Red/white	398 a	2.4 a	2.8 a
	White	418 a	2.4 a	3.1 b
Proloog	Red/white	422 a	2.5 a	3.0 a
	White	449 b	2.5 a	3.2 a

Discussion

Absence of blue light in the spectrum may have caused internode elongation and greater leaf area under narrow-band red/white LED. Yield about 14% higher for both cultivars for broadband white LED, resulting from higher total biomass production. Partitioning was unaffected by the light treatments. Harvested fruits were of equal to better quality under broadband white LED.

Conclusions

White LEDs resulted in more compact plants, higher yields, and a more ergonomically pleasant environment compared to narrow-band red/white LED.

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