

Research Article



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## 삼채(*Allium hookeri*) 잎 연중생산을 위한 식물공장 환경제어 효과

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2

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### Environmental Control in the Plant Factory System Influences Year-Round Production of *Allium hookeri* Leaves

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#### Abstract

The demand for the fresh leaf of hooker chive, which is mainly used as functional roots and contains dietary sulfur or saponin, is increasing, but the leaves are only harvested 3-4 times per year under conventional field conditions. A plant factory system with different light qualities or intensities was applied for year-round production of the fresh leaves. Hooker chive (*Allium hookeri*) roots were hydroponically cultured under the plant factory with a mixture of blue plus red LEDs (Light-Emitting Diodes) and fluorescent lights for 50 weeks. Maximum leaf growth was attained with the 1.5 dS/m EC in the culture medium under the plant factory. The average leaf and shoot numbers of hooker chive grown

hydroponically under a mixture of 200  $\mu\text{mol}/\text{m}^2/\text{s}$  LEDs increased by 147% and 140%, respectively compared to those under 100  $\mu\text{mol}/\text{m}^2/\text{s}$  LEDs at the 10th harvest. The leaf length of hooker chive grown under the LEDs treatment with the lowest light intensity significantly increased by 27% compared with the natural light treatment at the 10th harvest. However, there was no significant difference in leaf pigmentation between natural and 200  $\mu\text{mol}/\text{m}^2/\text{s}$  LEDs treatments. Plant factory with the mixture LEDs of blue and red lights can be applied for year-round production of hooker chive fresh leaves to ensure a stable supply of leafy vegetable throughout the year.

**Key words:** Artificial light Control, Mixture radiation, Year-round production

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서론

(三葉) (參菜) 가

2010

[4,5,7,14,17].

가 가

가

가

[13,15].

가

(LEDs, Light-Emitting Diodes) [8,11]

가

[13,15]

가

[6,9].

재료 및 방법

식물재료 및 재배조건

3~4 6 cm 가

(*Allium hookeri*, Hooker chive,

1-31L919C1)

1% 10

1

(Light-Emitting Diodes, LEDs, L-

PEC, Jeonju, Korea)

(Deep Flow Technique)

Yamazaki (N: 6.5, P: 1.5, K: 4.0, Ca: 2.0, Mg: 1.0 me/L)

EC (Electric Conductivity) 0.5, 1.0 1.5 dS/m 3

660±10 460±10 nm

36 W LEDs 1:1 LEDs

(LEDs-L ), 150 (LEDs-M ) 100 200 μmol/m<sup>2</sup>/s (LEDs-H ) 3

Fig. 1

LEDs Spectral PAR Meter (PG-200N, UPRTek, Taiwan)

( , 68,

14.73, 4, 7, 6, 0.201%)

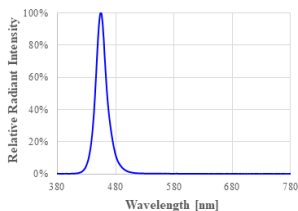
m<sup>2</sup>/s 150 μmol/

36 W Cool-White

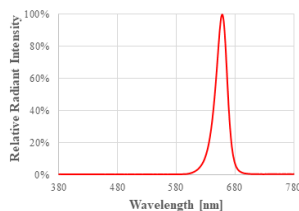
35

143

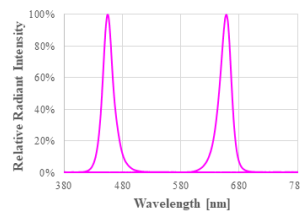
μmol/m<sup>2</sup>/s



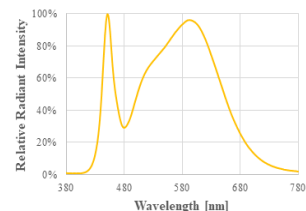
<Blue LEDs>



<Red LEDs>



<Blue+Red LEDs>



<Fluorescent lamp>

Fig. 1. Spectrum distribution of the blue, red or blue plus red light provided by LEDs and fluorescent lights tested in the experiment.

결과 및 고찰

26±8°C 76±20%  
 1 12  
 23±1°C 60±5%

생장량 조사 및 통계분석

3 20 EC  
 1 cm 1  
 7 5 10  
 SPAD  
 (SPAD-502, Minolta Spectrum Tech., USA)  
 70°C  
 (VS-1202D4, VISION Co., Ltd, Korea)  
 3  
 SAS (Version  
 6.21; SAS Institute Inc., Cary, NC, USA)  
 ANOVA Duncan  
 (P=0.05)

(Fig. 2).  
 LEDs Yamazaki EC 0.5, 1.0, 1.5  
 dS/m 3  
 1.0 1.5 dS/m EC  
 가 (Fig. 3). 5 7  
 EC 1.0  
 1.5 dS/m EC 0.5 dS/m  
 23% 21% 가 EC 1.0 1.5 dS/m  
 EC  
 SPAD 12% 가  
 EC 1.5 dS/m  
 EC 1.5  
 dS/m  
 [1].

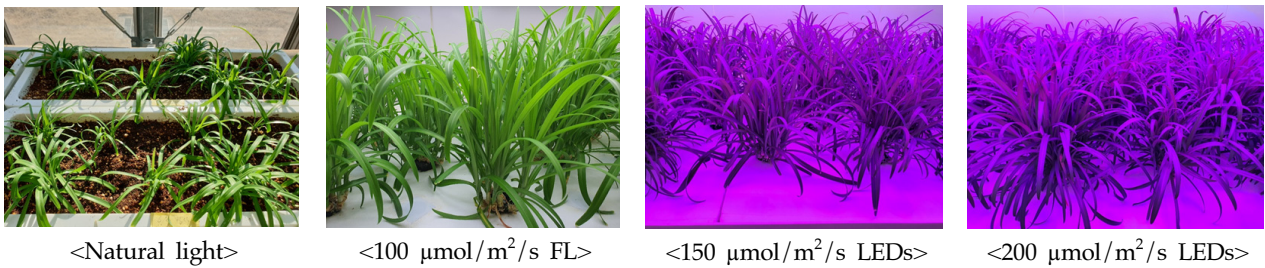


Fig. 2. Hooker chive Growth cultured conventionally or hydroponically under the natural light or mixture radiation of blue plus red LEDs with different light intensities and conventional fluorescent light (FL) for 5 weeks under the greenhouse or plant factory conditions.

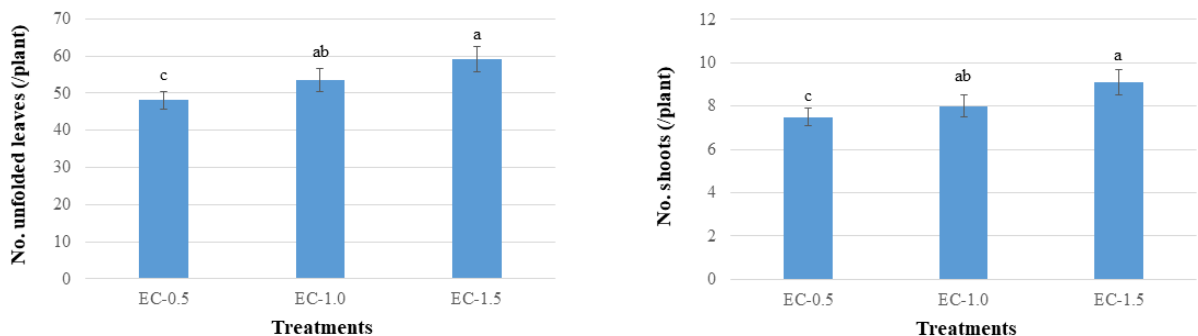


Fig. 3. Numbers of unfolded leaves (left) and shoots (right) of hooker chives cultured hydroponically under the different EC levels in a plant factory conditions with the mixture radiation of blue plus red LEDs. Vertical bars represent standard error (harvest number=8).

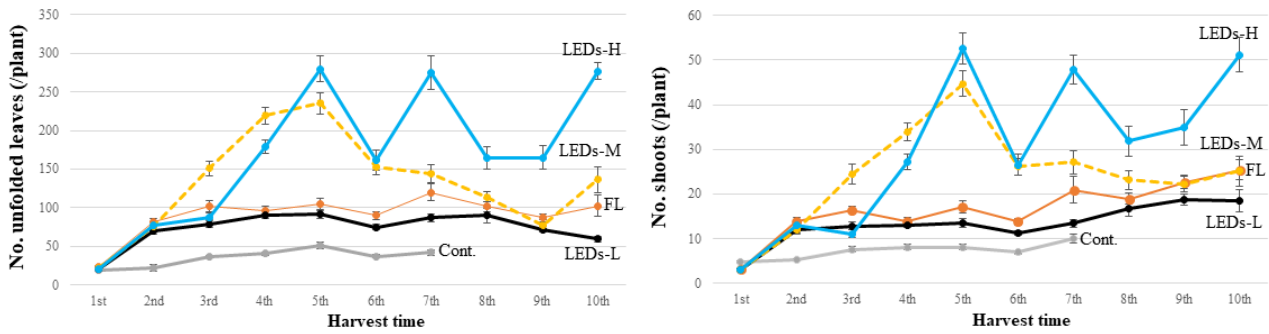


Fig. 4. Time courses of numbers of unfolded leaves (left) and shoots (right) of hooker chives cultured conventionally or hydroponically under the mixture radiation of blue plus red LEDs with different light intensities, (LEDs-L of 100  $\mu\text{mol}/\text{m}^2/\text{s}$ , LEDs-M of 150  $\mu\text{mol}/\text{m}^2/\text{s}$  and LEDs-H of 200  $\mu\text{mol}/\text{m}^2/\text{s}$ ), fluorescent light (FL of 150  $\mu\text{mol}/\text{m}^2/\text{s}$ ) and natural light (Cont.) considered as a control in a plant factory system for 50 weeks after the treatments. Vertical bars represent standard error (harvest number=10). Hooker chive leaves were 7 times harvested in Control.

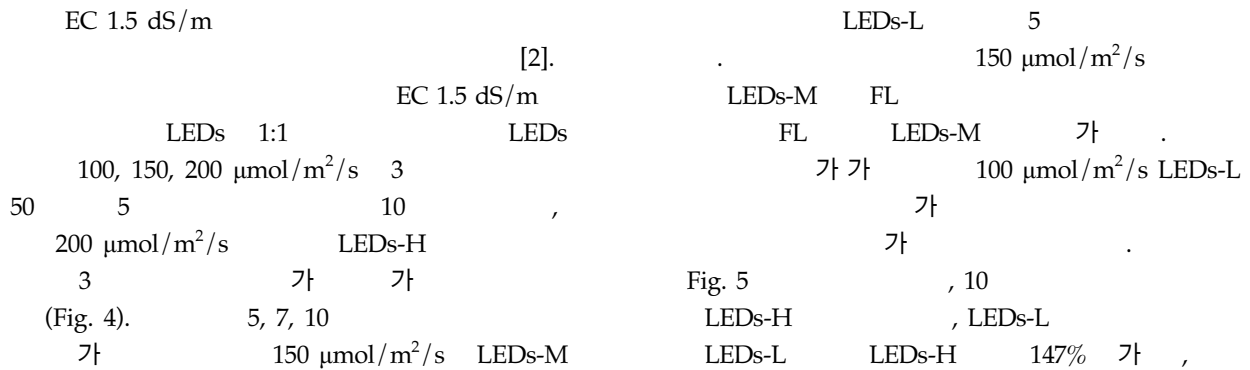


Fig. 5. Annual average of the number of leaves, shoots, and fresh weight of hooker chives cultured conventionally or hydroponically under the mixture radiation of blue plus red LEDs with different light intensities (LEDs-L of 100  $\mu\text{mol}/\text{m}^2/\text{s}$ , LEDs-M of 150  $\mu\text{mol}/\text{m}^2/\text{s}$ , LEDs-H of 200  $\mu\text{mol}/\text{m}^2/\text{s}$ ), fluorescent light (FL of 150  $\mu\text{mol}/\text{m}^2/\text{s}$ ) considered as a control in a plant factory system for 50 weeks after the treatments. Vertical bars represent standard error (n=200). Different letter indicates significantly different at the 5% level by Duncan's multiple range test. \*means average harvested 7 times under greenhouse conditions.

Fig. 5. Annual average of the number of leaves, shoots, and fresh weight of hooker chives cultured conventionally or hydroponically under the mixture radiation of blue plus red LEDs with different light intensities (LEDs-L of 100  $\mu\text{mol}/\text{m}^2/\text{s}$ , LEDs-M of 150  $\mu\text{mol}/\text{m}^2/\text{s}$ , LEDs-H of 200  $\mu\text{mol}/\text{m}^2/\text{s}$ ), fluorescent light (FL of 150  $\mu\text{mol}/\text{m}^2/\text{s}$ ) considered as a control in a plant factory system for 50 weeks after the treatments. Vertical bars represent standard error (n=200). Different letter indicates significantly different at the 5% level by Duncan's multiple range test. \*means average harvested 7 times under greenhouse conditions.

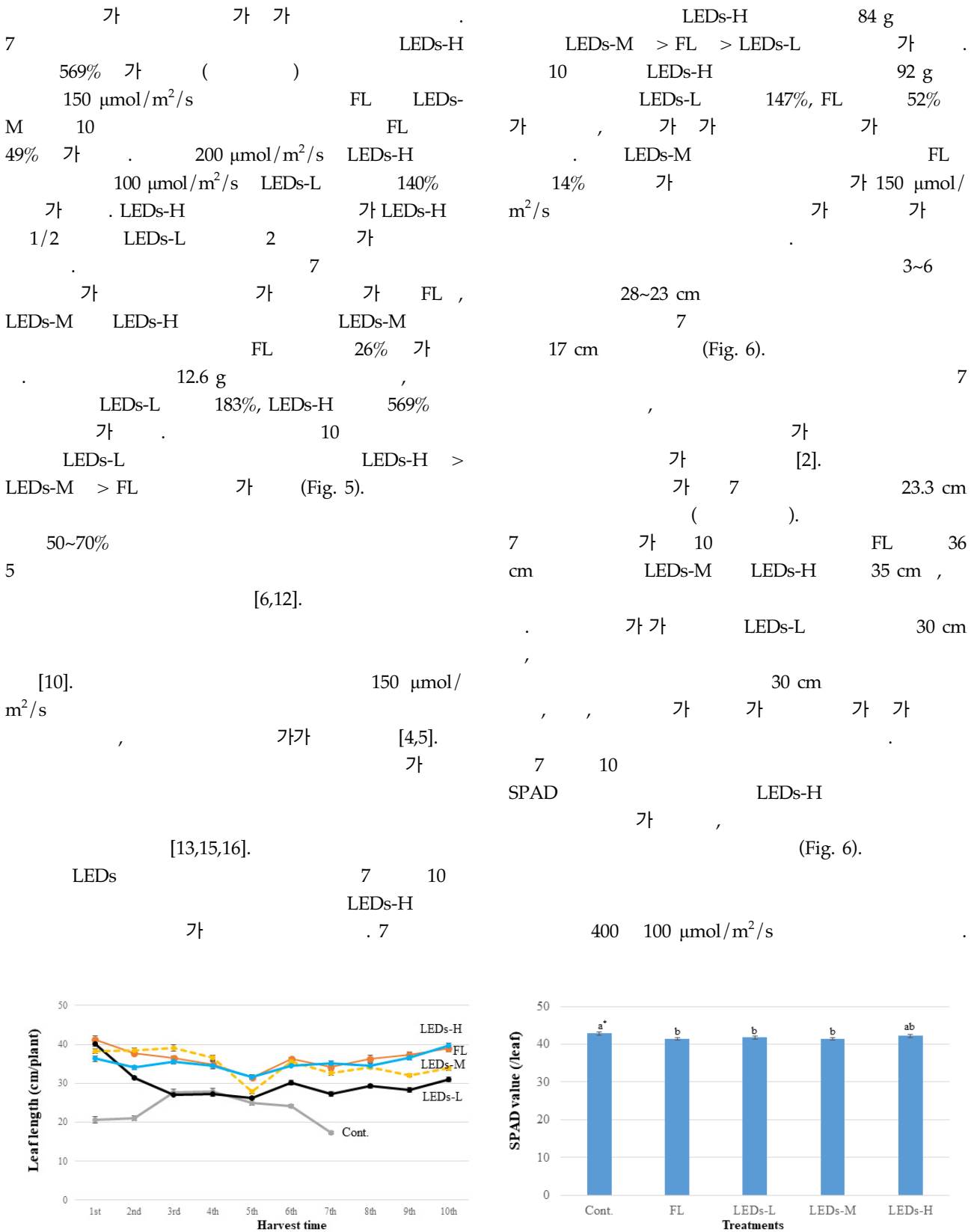


Fig. 6. Time courses of leaf length and SPAD value of hooker chives hydroponically cultured under the mixture radiation of blue plus red LEDs with different light qualities, (LEDs-L of  $100 \mu\text{mol}/\text{m}^2/\text{s}$ , LEDs-M of  $150 \mu\text{mol}/\text{m}^2/\text{s}$  and LEDs-H of  $200 \mu\text{mol}/\text{m}^2/\text{s}$ ), fluorescent light (FL of  $150 \mu\text{mol}/\text{m}^2/\text{s}$ ) considered as a control in a plant factory system for 50 weeks after the treatments. Vertical bars represent standard error (harvest number=10). Hooker chive leaves were 7 times harvested in Control.

LEDs  
가  
가  
[1,2].  
50~70%  
[7,9,12].  
m<sup>2</sup>/s  
150 μmol/  
[2,10].  
LEDs  
가  
가  
가  
가  
가  
[3].  
500~1,000 μmol/m<sup>2</sup>/s  
3  
가가  
[3,8,18].  
가  
LED

### Note

The authors declare no conflict of interest.

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