COVER STORY

# ROOTING HERB CUTTINGS: WHY DAILY LIGHT INTEGRAL MATTERS

Researchers share the latest findings on supplemental lighting's effects on rooting.

By Annika E. Kohler and Roberto G. Lopez

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## Consumer demand for fresh and dried culinary herbs in the U.S. has driven growers to produce locally grown culinary herbs year-round.

Season extension via row covers and high tunnels as well as year-round controlled environment production in greenhouses, and indoor vertical farms has allowed culinary herbs to be available out of season, thus meeting demands of market goers and chefs alike. Even with indoor production, during the winter the majority of fresh culinary herbs sold in the U.S. are produced in other countries.

Culinary herbs can be produced from seed and increasingly from shoot-tip cuttings, the former of which can have slow or poor germination and may be difficult to produce. In addition, vegetative cuttings allow growers to produce true-to-type plants which are more desirable and reduce young plant production time.

### Daily Light Integral (DLI) learnings

Previous MSU research has determined that maintaining a DLI of 8 to 12 mol·m$^{-2}$·d$^{-1}$ during herbaceous floriculture crop young plant production produces high-quality plugs and liners, and reduces production time by 2 to 3 weeks depending on the genera.

However, little research-based information is available on the DLI requirements for rooting culinary herbs from shoot-tip cuttings. Subsequently, many growers produce culinary herb young plant under a range of DLIs up to 20 mol·m$^{-2}$·d$^{-1}$.

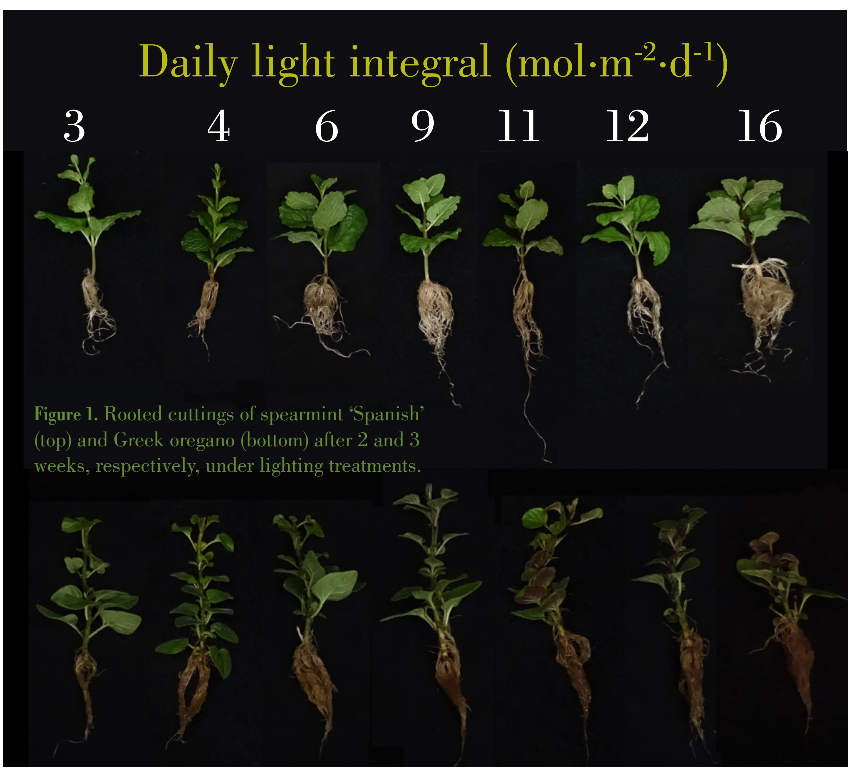


**Figure 1.** Rooted cuttings of spearmint 'Spanish' (top) and Greek oregano (bottom) after 2 and 3 weeks, respectively, under lighting treatments.

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Taking the limited production information into consideration, we wanted to establish environmental protocols for producing culinary herb liners. We wanted to determine the daily light integral (DLI) range that would lead to uniform, complete rooting and high-quality liners of five economically important culinary herbs. In this first article, of the five-part series, we will show you how the DLI can be used to reduce rooting time and produce high-quality culinary herb liners.

*(Editor's Note: In this first installment in a five-part series looking at results from Michigan State University's culinary herb research program. we will show you how the proper DLI can be used to reduce rooting time and produce high-quality culinary herb liners.)*

### Experimental protocol

***Plant material.*** Shoot-tip cuttings of Greek oregano (*Origanum vulgare*), rosemary 'Arp' (*Rosmarinus officinalis*), sage 'Extrakta' (*Salvia officinalis*), spearmint 'Spanish' (*Mentha spicata*), and thyme 'German Winter' (*Thymus vulgaris*) were stuck into 72-cell (28-mL individual cell volume) trays filled with a 50:50 (volume to volume) ratio of soilless substrate and coarse perlite.

***Propagation environment.*** Trays were placed on a bench with a root-zone heating set point of 73 °F (23 °C) in a glass-glazed greenhouse with an air average daily temperature set point of 73 °F (23 °C) and a vapor pressure deficit of 0.3 kPa. A 56% aluminum shade cloth was used to reduce the DLI to ≈5 $mol \cdot m^{-2} \cdot d^{-1}$ for 5 days to induce callus. A 16-h photoperiod was created by natural daylight and supplemental lighting from high-pressure sodium (HPS) lamps which provided light from 6-8 AM and 5-10 PM and turned on from 8-5 PM when the photosynthetic photon flux density was below ≈440 $\mu mol \cdot m^{-2} \cdot s^{-1}$. Overhead mist containing reverse osmosis water with a water-soluble fertilizer that provided 60 ppm nitrogen misted cuttings as necessary.

After callusing, trays were dispersed among DLI treatments of ~3 to ~16 $mol \cdot m^{-2} \cdot d^{-1}$ that were created with the use of no shade or shade cloth ranging from 36 to 76%. After 2

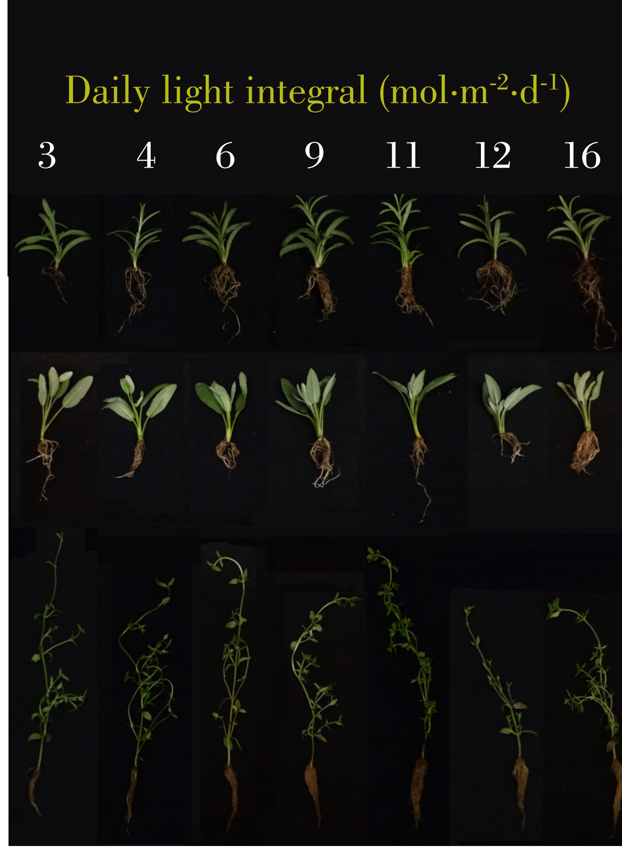


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**Figure 2.** Rooted cuttings of (top to bottom) rosemary 'Arp', sage 'Extrakta', and thyme 'German Winter' after 3 weeks of lighting treatments.

or 3 weeks, cuttings were harvested and morphological data was quantified to determine liner quality.

The following four plant characteristics exhibited the most significant variances when DLI was either increased or decreased:

## Results

***Stem length.*** As the DLI during rooting increased from ~3 to ~16 mol·m$^{-2}$·d$^{-1}$, the stem length of oregano and thyme decreased by 36%, and 27%, respectively (**Fig. 1**). Stem length of spearmint decreased by 12% as DLI increased from ~3 to ~12 mol·m–2·d–1, **(Fig. 1 and 2)** while DLI did not influence stem length of rosemary or sage **(Fig. 2).**

***Stem caliper.*** The stem caliper of thyme and sage increased by 49% and 23% as DLI increased from ~3 to ~11 and ~15 mol·m$^{-2}$·d$^{-1}$, respectively (**Fig. 2**). As the DLI increased to ~16 mol·m$^{-2}$·d$^{-1}$, stem caliper of sage and thyme decreased. The stem caliper of oregano, rosemary, and spearmint increased by 26%, 28%, and 30% as DLI increased from ~3 to ~16 mol·m$^{-2}$·d$^{-1}$ (**Fig. 1 and 2**).

***Root dry mass.*** As the DLI increased from ~3 to ~16 mol·m$^{-2}$·d$^{-1}$, the root dry mass of sage increased linearly by 421% **(Fig. 2)**. Additionally, the root dry mass of spearmint and rosemary curvilinearly increased by 328% and 449%, respectively, as DLI increased from ~3 to ~16 mol·m$^{-2}$·d$^{-1}$ (Fig. 1 and 2). The root dry mass of oregano and thyme increased by 106% and 436% as DLI increased to ~12 and ~14 mol·m$^{-2}$·d$^{-1}$, respectively (**Fig. 1 and 2**). Further increases in DLI did not increase root dry mass for oregano and thyme **(Fig. 1 and 2)**.

***Shoot dry mass.*** The shoot dry mass of oregano and spearmint linearly increased by 117% and 125%, as DLI increased from ~3 to ~16 mol·m$^{-2}$·d$^{-1}$ (**Fig. 1**). At a DLI of ~14 mol·m$^{-2}$·d$^{-1}$, the shoot dry mass of rosemary increased up to 53% and at a DLI of ~13 mol·m$^{-2}$·d$^{-1}$, shoot dry mass of sage and thyme was 104% and 142% greater, compared to a DLI of ~3 mol·m$^{-2}$·d$^{-1}$ **(Fig. 2)**. As DLI increased to ~16 mol·m$^{-2}$·d$^{-1}$, the shoot dry mass of sage and thyme decreased by 8% and 5%. (**Fig. 2**).

## Take-home message

High-quality liners of oregano, sage, spearmint, rosemary, and thyme were produced under DLIs between ~11 and ~16 mol·m$^{-2}$·d$^{-1}$, which is higher than propagation protocols for rooting floriculture crops.

Whereas, a DLI of ~11 to ~12 mol·m$^{-2}$·d$^{-1}$ was best for thyme. Spearmint liners produced under the highest DLI of ~16 mol·m$^{-2}$·d$^{-1}$ were of exceptional quality as they were compact,

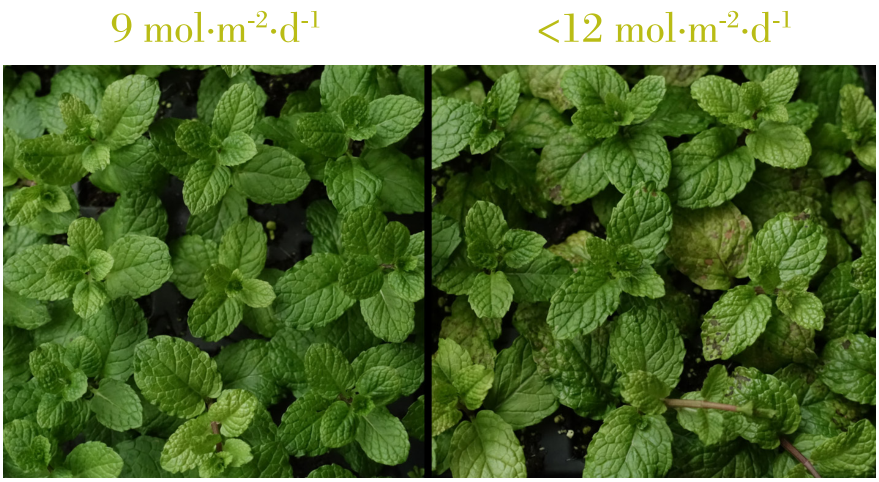


**Figure 3.** Liners of spearmint 'Spanish' under a DLI of 9 $mol·m^{-2}·d^{-1}$ in contrast to a DLI <12 $mol·m^{-2}·d^{-1}$ which developed necrotic lesions on the leaves.

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had higher root, shoot, and total dry masses, and a greater stem caliper.

However, necrotic lesions developed on leaves **(Fig. 3)** as a result of the high DLI. From the overall rooting results, desirable characteristics, and aesthetics of liners from this experiment, we suggest propagating fast-rooting herbs such as spearmint and oregano cuttings under a DLI of 11 to ≤15 $mol·m^{-2}·d^{-1}$ for 9 to 11 days after callusing. Slow-rooting culinary herbs such as rosemary and sage will require at least 3 weeks under a DLI of 11 to ≤15 $mol·m^{-2}·d^{-1}$ after callusing, and thyme cuttings should be propagated under a DLI of ~11 to ~12 $mol·m^{-2}·d^{-1}$ for at least three weeks after callusing for best liner quality. We would also like to note that higher DLIs (≥12 $mol·m^{-2}·d^{-1}$) may result in leaf chlorosis and/or necrosis **(Fig. 3)** but this does not affect the final product once moved into a common growing environment and fertilized with higher nitrogen rates. **pg**

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