CULINARY HERBS:

To flower or not to flower?

By Roberto G. Lopez
and Charlie Garcia

The critical photoperiods of new cultivars of culinary herbs have yet to be determined, so researchers set out to observe whether changes in photoperiod or day length influence flower initiation in herbs like basil, oregano, mint and more.

PHOTOS COURTESY OF ROBERTO G. LOPEZ

Editor's Note: In this third article from a five-part series on potted and hydroponic culinary herb research at Michigan State University, researchers share the results of several studies showing how you can inhibit or promote flowering.

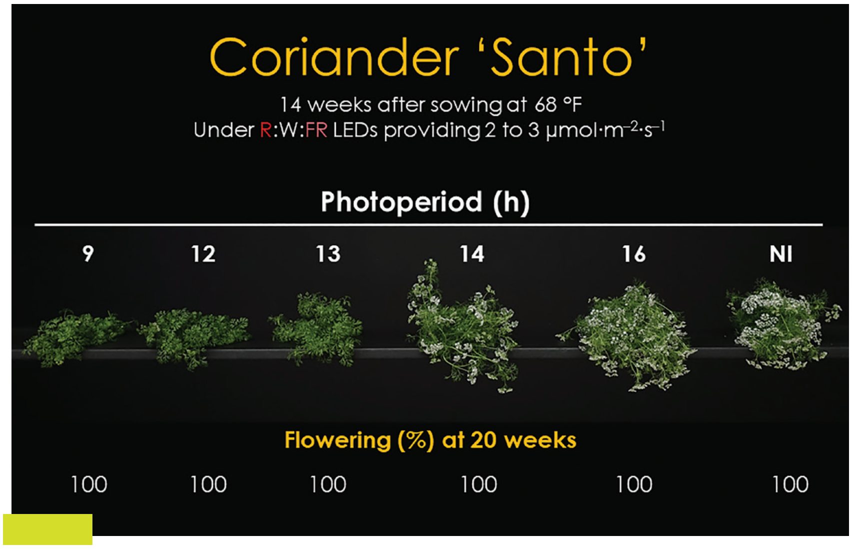

Figure 1. Flowering percentage of Coriander 'Santo' grown under a truncated 9-h short day (SD) or under a 9-h SD extended with red+white+far-red (R+W+FR) light-emitting diode (LED) lamps to achieve 12-, 13-, 14-, and 16-h photoperiods or a 4-h night interruption (NI).

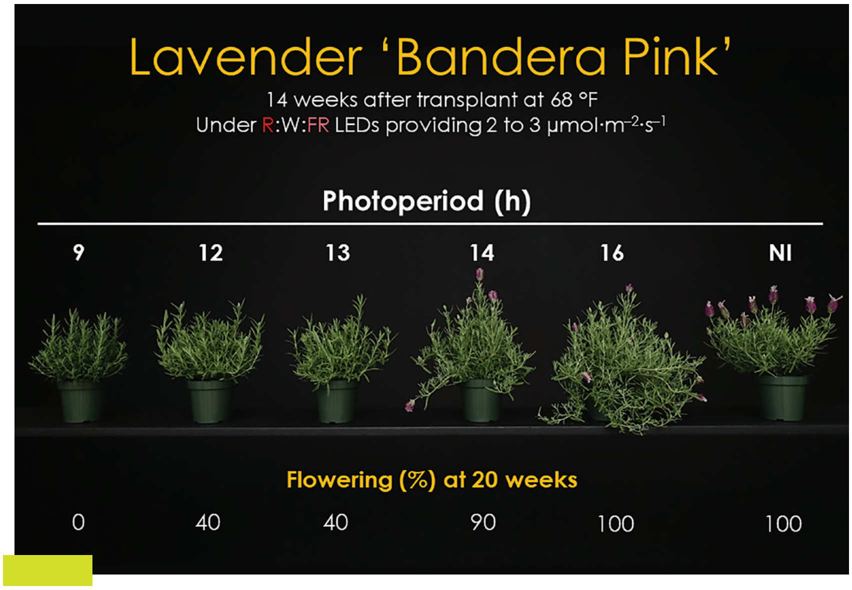

Figure 4. Flowering percentage of Lavender 'Bandera Pink' grown under a truncated 9-h short day (SD) or under a 9-h SD extended with red+white+far-red (R+W+FR) light-emitting diode (LED) lamps to achieve 12-, 13-, 14-, and 16-h photoperiods or a 4-h night interruption (NI).

An issue that culinary herb growers face is the inability to keep crops vegetative as both retailers and customers often demand non-flowering, fresh-cut leafy greens and culinary herbs. For producers, flowering of culinary herbs such as basil, cilantro, mint, oregano and watercress is usually undesirable, since vegetative growth can stall once flower initiation occurs. Additionally, once herbs become reproductive, flavors can be altered and less appealing to consumers.

Alternatively, flower induction protocols are lacking for herbs such as basil and lavender that are marketed for ornamental purposes as bedding plants or cut flowers, or for those used in the production of essential oils. In these cases, flowers are desired as consumers are more likely to purchase a flowering ornamental or cut flower herb arrangement, and aromatic oil concentrations are maximized when plants are in flower.

Greenhouse growers of floriculture crops often delay or promote flowering by manipulating the photoperiod (day length), temperature or the cumulative amount of light that a plant receives over the course of a day (the daily light integral). For example, the day length in a greenhouse can be easily modified by creating short day (SD) lengths during naturally long days (LD); or by creating LD lengths during naturally SDs.

To create SDs, light-blocking opaque black cloths are pulled over plants to shorten the natural day length and artificially create a SD. Low-intensity photoperiodic lighting providing 2 to 3 $\mu mol \cdot m^{-2} \cdot s^{-1}$ is most often used to create LDs. It can be delivered in one of two ways: 1) at the end or beginning of the day to extended the day (day-extension lighting), or 2) during the middle of the night from 10 p.m. to 2 a.m. (night-interruption lighting).

In addition to photoperiod, some plants can exhibit a facultative irradiance response (FIR) where they flower faster as a result of the juvenile stage of development being shortened under higher DLIs. Plants exhibiting a FIR develop fewer leaves or nodes below the first open flower than those grown under lower DLIs.

Although some studies have been conducted to determine what environmental factors induce some common culinary and ornamental herbs and leafy greens into flower, the critical photoperiod of new cultivars and many other genera have not yet been determined. Therefore, our goal was 1) to determine if photoperiod and/or DLI influence flower initiation and development of culinary and ornamental herbs and leafy greens and 2) to identify the critical photoperiod that induce flowering of those crops that response to day length.

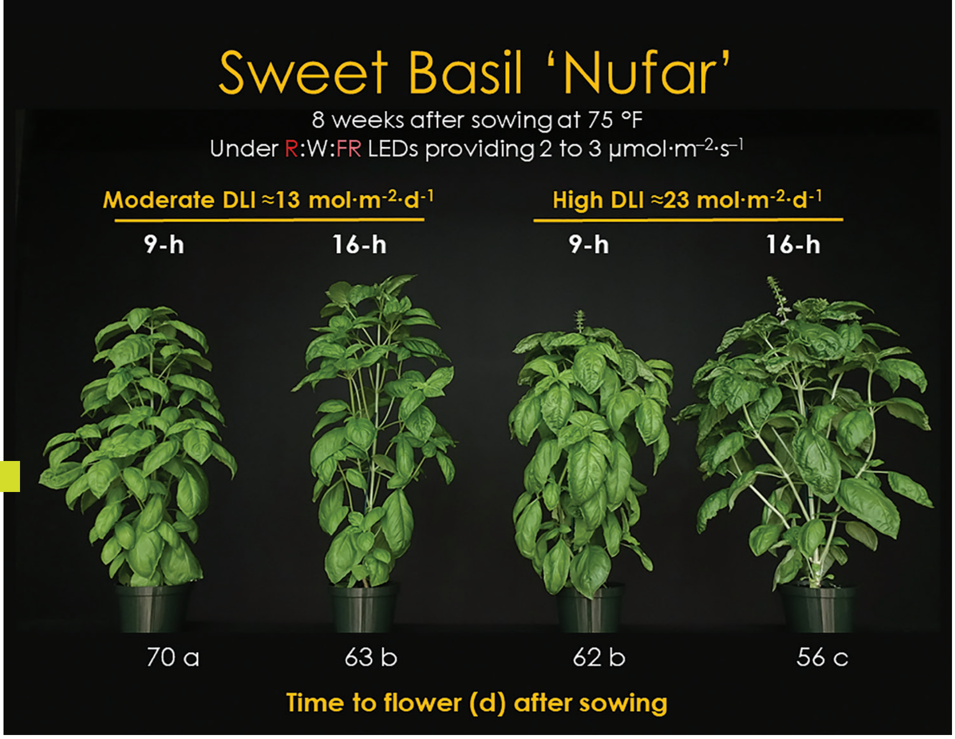

Figure 3. Flowering of Sweet Basil 'Nufar' grown under a daily light integral (DLI) of 13 or 23 mol·m–2·d–1 and either under a truncated 9-h or 16-h photoperiod.

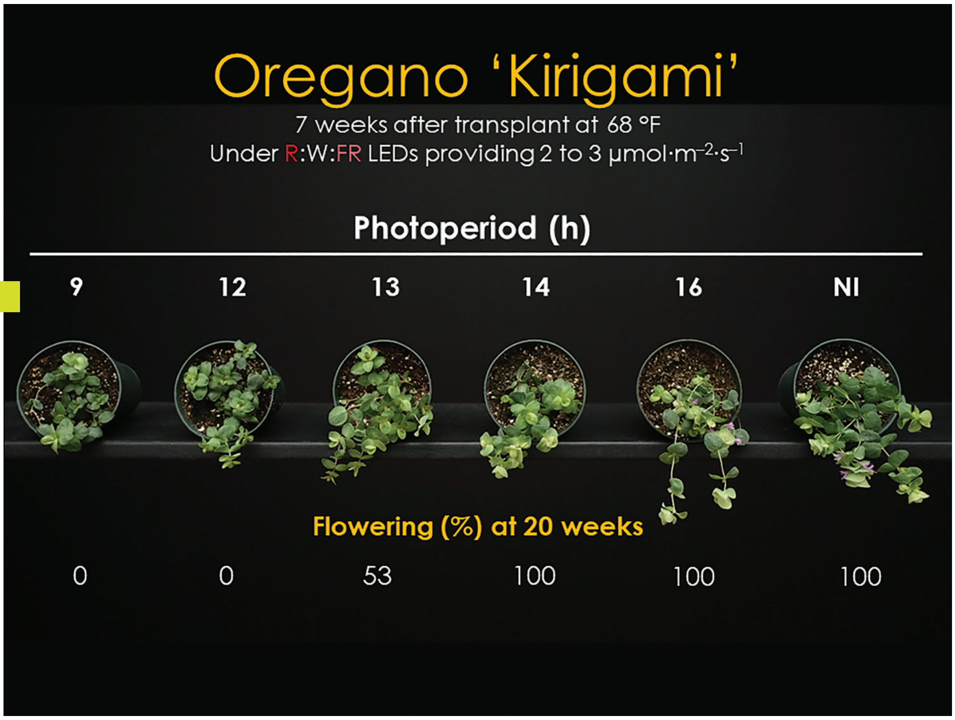

Figure 4. Flowering percentage of Oregano 'Kirigami' grown under a truncated 9-h short day (SD) or under a 9-h SD extended with red+white+far-red (R+W+FR) light-emitting diode (LED) lamps to achieve 12-, 13-, 14-, and 16-h photoperiods or a 4-h night interruption (NI).

The study

Cuttings of spearmint 'Spanish' were harvested and rooted utilizing protocols outlined in our first article in this series. Seeds of Greek basil (*Ocimum minimum* 'Pluto'), holy basil (*O. tenuiflorum*), lemon basil (*O. ×citriodorum* 'Lime'), purple basil (*O. basilicum* 'Red Ruben'), sweet basil (*O. basilicum* 'Cinnamon', 'Genovese', 'Nufar' and 'Sweet Dani Lemon'), and Thai basil (*O. basilicum* var. *thrysiflora* 'Sweet Thai'), oregano 'Kirigami' and 'Greek,' lavender 'Bandera Pink,' coriander 'Santo,' dill 'Bouquet,' watercress and marjoram were sown into 128-cell plug trays.

After germination, seedlings were thinned to one plant per cell. The seedlings or rooted cuttings were subsequently transplanted into 4.5- or 6-inch pots filled with a peat and perlite substrate. Basil was grown in a greenhouse with an air average daily temperature (ADT) of 75º F (24º C) and under DLIs of 7, 13, or 23 mol·m^{-2}·d^{-1}. All other culinary herbs were grown at an air ADT of 68º F and DLI of 10 mol·m^{-2}·d^{-1}.

Each day, black cloth was pulled over individual benches at 5 p.m. and opened at 8 a.m. to create a 9-hour (9-h) SD photoperiod. Treatments consisted of a 9-h SD or a 9-h SD with day extension lighting from four light-emitting diodes (LEDs) providing 2 to 3 µmol·m^{-2}·s^{-1} of red:white:far-red light on each bench to create a 11, 12, 13, 14, 15 or 16-h photoperiods or a 4-h night interruption from 10 p.m. to 2 a.m.

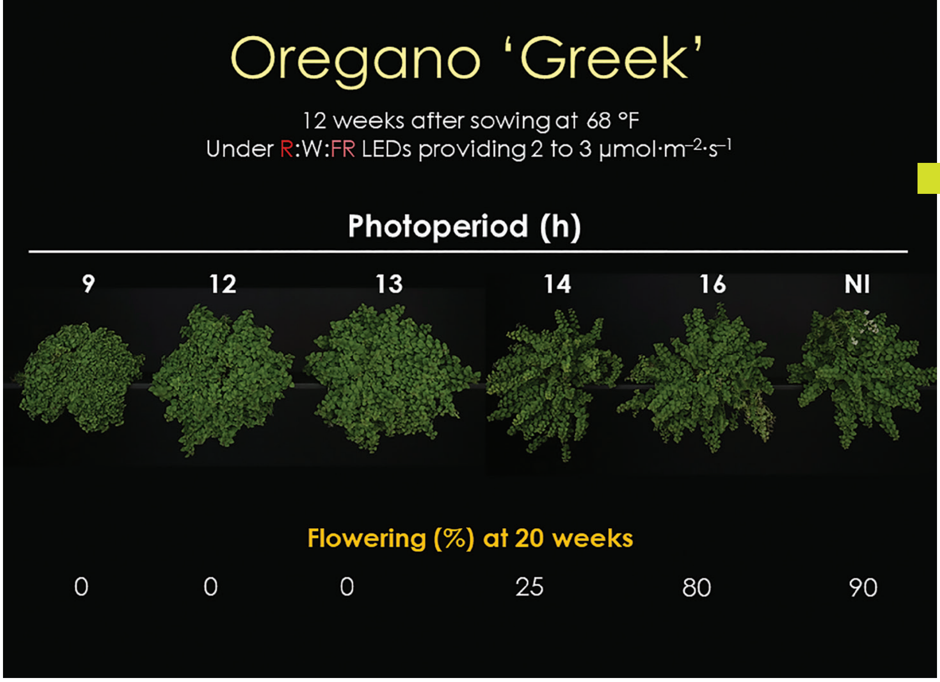

Figure 5. Flowering percentage of Oregano 'Greek' grown under a truncated 9-h short day (SD) or under a 9-h SD extended with red+white+far-red (R+W+FR) light-emitting diode (LED) lamps to achieve 12-, 13-, 14-, and 16-h photoperiods or a 4-h night interruption (NI).

What did we find?

Time to first visible bud occurred more rapidly under LD photoperiods (≥13 h) for coriander, dill, lavender and marjoram. The node number under the first open flower was greater under a 9-h SD for coriander, dill, lavender and marjoram, and generally decreased as day length increased to 16 h or under a 4-h night interruption (see **Figures 1 and 2**). Time to flower of Sweet 'Nufar', purple, and Thai basil, coriander 'Santo', lavender 'Bandera Pink', dill 'Bouquet' and marjoram was hastened under LDs, but they eventually flowered under SDs (see **Figure 3**). Therefore, these herbs were classified as facultative LD plants. After 20 weeks, nearly all dill and coriander plants flowered regardless of photoperiod. However, when grown under a 9-h SD, dill and coriander were more much more compact at first open flower in comparison to plants grown under LD photoperiods ≥13 h (see **Figure 1**).

Flowering of sweet basil ('Genovese', 'Cinnamon' and 'Sweet

Dani Lemon'), lemon and Greek basil was not influenced by photoperiod and were classified as day neutral plants. Lastly, holy and lemon basil, and 'Nufar' flowered faster under high DLIs (>20 mol·m^{-2}·d^{-1}), compared to under moderate DLIs (>10 mol·m^{-2}·d^{-1}) and were classified as having FIR (see **Figure 3**).

Watercress and oregano 'Kirigami' only produced visible buds and open flowers under LD photoperiods ≥13-h (see **Figure 4**). Oregano 'Greek' and spearmint only produced visible buds and flowered under a 16-h photoperiod or a 4-h night interruption (see **Figure 5**). These herbs were classified as obligate LD plants, requiring ≥13-h, ≥14-h, and 16, or night interruption lighting, respectively, for visible bud initiation and flowering to occur.

Grower recommendations

Grow the following culinary herbs under short day lengths of ≤12 h to prevent or delay flowering:

- Coriander 'Santo'
- Dill 'Bouquet'
- Marjoram
- Oregano 'Greek' and 'Kirigami'
- Spearmint 'Spanish'
- Sweet 'Nufar', purple, and Thai basil
- Watercress

Grow the following culinary herbs under low to moderate DLIs of 7 to 15 mol·m–2·d–1 to delay flowering:

- Holy and lemon basil
- Basil 'Nufar'

Grow the following ornamental herbs under long day length of ≥14 h or a 4-h night interruption to induce flowering:

- Lavender 'Bandera Pink'
- Oregano 'Greek' 'Kirigami'

It is important to remember that the day length provided during the young plant stage can influence flowering responses. Additionally, production temperatures and DLIs can also impact flowering of culinary herbs. **pg**

Charlie Garcia was a M.S. student at Michigan State University and Roberto Lopez is an Associate Professor and Controlled Environment/Floriculture Extension Specialist in the Department of Horticulture at MSU. The authors gratefully acknowledge Caleb Spall for assistance, Signify for LEDs, JR Peters for fertilizer, The Fred C. Gloeckner Foundation and MSU AgBioResearch Project GREEEN, MSU Graduate School, and the USDA-NIFA for funding.