Part 12 of our 14-part series on herbaceous perennials takes a look at quick cropping three species: Achillea 'Moonshine,' Gaura lindheimeri, and Phlox paniculata.

By AMY ENFIELD, ERIK RUNKLE, ROYAL HEINS, ARTHUR CAMERON, and WILLIAM CARLSON

In our previous article we discussed the keys to success for quick-cropping of herbaceous perennials. The primary objective of quick-cropping herbaceous perennials is to efficiently and rapidly propagate, bulk, and force high quality perennials in a uniform and predictable manner. The sequence of quick-cropping is stock plant management, propagation, bulking, cooling (if needed), and forcing into flower.

In this article we will discuss the specifics for quick-cropping three photoperiodic species: Achillea 'Moonshine,' Gaura lindheimeri 'Whirling Butterflies' and 'Siskyou Pink,' and Phlox paniculata.

Achillea 'Moonshine'

Stock Plant Management

Achillea 'Moonshine' should be maintained under photoperiods of 13 hours or less to maintain vegetative growth. This requires pulling black cloth over plants from about March 15 through September 15 in most of the Northern hemisphere. When daylengths are longer, black cloth can be used to exclude light. One strategy is to pull black cloth at 5 p.m. and open it at 8 a.m., which creates a nine-hour day. Any combination of opening and closing that gives at least 11 hours of darkness (maximum 13 hours light) is also acceptable.

Achillea 'Moonshine' stock plants should be grown at moderate temperatures around 64°F to 68°F (18°C to 20°C) during the winter. Plants will tolerate higher temperatures (in the 70s°F) during the summer. Cuttings should be harvested every four to five weeks to ensure continued branching and cutting production (Figure 1).

Propagation

Tip cuttings should be propagated in plug flats containing well-drained media, such as a 50% peat, 50% perlite mixture. Moisture control is important to avoid rot of 'Moonshine' leaves, which, in our experience, has been the biggest problem with propagation of achillea. Rooting hormone, such as a 1,500-ppm liquid IBA dip, accelerates rooting and improves rooting uniformity. Like stock plants, achillea

Figure 1. Example of vegetative achillea 'Moonshine' stock plants growing under a 12-hour photoperiod with supplemental light during the winter.

Bulking

Achillea plugs should also be bulked under noninductive photoperiods of 13 hours or less (Figure 2). The duration of bulking is dependent on the size of the finish pot. For example, for a five-inch pot, three weeks of bulking at 68°F (20°C) is adequate.

Vernalization

Achillea does not require a cold treat-
Forcing To Flowering

Achillea 'Moonshine' requires photoperiods of 14 hours or greater to flower, which occurs naturally from late April to mid-August in most of the United States. During the rest of the year, we suggest a four-hour night interruption from 10 p.m. to 2 a.m., with a minimum of 10 footcandles from any electrical light source. For forcing during low light periods of the year, supplemental lighting should be provided to improve plant quality.

From the start of long days, achillea 'Moonshine' takes six weeks to first flowering at 68°F (20°C). Total crop time from the start of propagation to first flower for a five-inch pot is 12 weeks (Table 1).
Table 1. Recommended temperatures and photoperiods and minimum production durations (in weeks) for five-inch flowering pot plant production.

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<thead>
<tr>
<th>Species</th>
<th>Stock Plants</th>
<th>Propagation</th>
<th>Bulking</th>
<th>Cooling</th>
<th>Forcing</th>
<th>Total</th>
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<tr>
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<td>73-77</td>
<td>65-70</td>
<td>35-41</td>
<td>68</td>
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<tr>
<td>Phlox paniculata</td>
<td>9</td>
<td>12-13</td>
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**Stage Of Production**

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<th>Weeks</th>
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<th>Weeks</th>
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**Temps (°F)**

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<td>Stock</td>
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<td>Forcing</td>
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**Table 1.** Therefore, gaura stock plants should be grown under a nine-hour photoperiod (15 hours of darkness). This means stock requires black cloth throughout the year in most of the United States, for example from 5 p.m. to 8 a.m.

But if maintaining a nine-hour photoperiod is not feasible, gaura cuttings will root even if reproductive. Stock plants should be grown at moderate temperatures around 64°F to 68°F (18°C to 20°C), and cuttings should be harvested every four to five weeks to ensure continued branching and cutting production.

**Propagation**

Tip cuttings should be propagated in plug flats containing well-drained media, such as a 50% peat, 50% perlite mixture. Like stock plants, to maintain vegetative plugs, gaura should be propagated under a nine-hour photoperiod. During propagation, the root zone temperature should be 73°F to 77°F (23°C to 25°C), and the relative humidity maintained around 90%. With these conditions, plug flats can be removed from propagation after two to three weeks.

**Bulking**

Gaura should also be bulked under a noninductive photoperiod (nine hours) using photoperiod control. The duration of bulking is dependent on the size of the finish container. For a

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**Figure 5. Gaura 'Whirling Butterflies' (a) and 'Siskyou Pink' (b) in full flower.**
PERENNIALS

SERIES

five-inch pot, three weeks of bulking at 68°F (20°C) is adequate. Plants should be pinched at the start of bulking to promote branching.

Vernalization

Gaura does not require a cold treatment to flower, but plug flats can be held in the cooler for later plantings if needed.

Forcing To Flowering

At 68°F (20°C), both gaura 'Whirling Butterflies' and 'Siskyou Pink' take six weeks from the start of forcing to flowering. For forcing during September to March, the photoperiod should be 12 hours or greater, or plants should be exposed to a four-hour night interruption with at least 10 footcandles.

During low light periods, supplemental lighting should be provided to improve plant quality. For forcing after March, natural light levels and photoperiods are sufficient (Figure 5).

Total crop time from the start of propagation to first flowering for a five-inch pot is around 12 weeks (Table 1).

Phlox paniculata

Stock Plant Management

Photoperiod requirements for stock management of Phlox paniculata require more precise control than for gaura and achillea. For both gaura and achillea, plants will produce vegetative cuttings if the photoperiod is shorter than some critical length.

But Phlox paniculata goes dormant if exposed to relatively short daylengths. Thus, the photoperiod must be sufficiently short to prevent flower induction, and sufficiently long to prevent the plant (and cuttings) from going dormant. To achieve this, the photoperiod needs to be shortened during the long days of summer, and lengthened during the short days of winter.

Further, the optimal photoperiod differs among cultivars. For example, 'Lilac Time' will remain vegetative under a 13-hour day while 'David' will flower (Figure 6). As a compromise to avoid both dormancy and reproductive development across cultivars, a 12- or 13-hour photoperiod should be used.

If stock plants are exposed to several weeks of photoperiods less than 12 hours, or if they lose vigor, plants should be exposed to six weeks of low temperature (41°F). This cooling period reinvigorates plants, and if placed under a proper daylength, promotes vegetative growth of Phlox paniculata plants.

To manage the photoperiod, a successful strategy is to light plants from 7 a.m. until sunrise and from sunset until 8 p.m. during the October 1 to March 1 time period. From April 1 to mid-September, black cloth should be pulled so that plants receive at least 11 hours of darkness each night (e.g., from 8 p.m. to 7 a.m.). The start and stop times can vary as long as the plants receive 11 hours of darkness each night.

The suggested photoperiod regimen above exposes plants to 13 hours of light and 11 hours of darkness. If one or more of the cultivars becomes reproductive under this photoperiod, then reduce the light period (such as to 12 hours) to better promote vegetative growth.

Phlox paniculata stock plants should be grown at moderate temperatures, 64°F to 68°F (18°C to 20°C) with high light intensities. Cuttings should be harvested every four to five weeks to ensure continued branching and cutting production.

Propagation

Tip cuttings should be propagated in plug flats containing well-drained media, such as a 50% peat, 50% perlite mixture. Rooting hormone, such as a 1,500-ppm liquid IBA dip, accelerates rooting and improves rooting uniformity. Phlox paniculata should be propagated under a 12- or 13-hour photoperiod, depending on cultivar, to maintain vegetative plugs using the photoperiod control described previously (Figure 7).

Flowering can occur if cuttings are rooted under an inductive photoperiod (Figure 8). During propagation, the root zone temperature should be 73°F to 77°F (23°C to 25°C), and the relative

Figure 6. Phlox paniculata cultivars differ in their critical photoperiod for flowering. 'Lilac Time' (a) grows vegetatively when photoperiods are 13 hours or less while 'David' (b) flowers when photoperiods are 13 hours or greater. Therefore, for vegetative growth, the daylength should be maintained between 12 and 13 hours if several cultivars are grown together.

Figure 7. A well-rooted vegetative Phlox paniculata 'Mt. Fuji' plug.

Figure 8. Phlox paniculata can flower prematurely in the plug tray if the photoperiod during propagation is sufficiently long to induce flowering.

March 2002 • Greenhouse Grower
humidity maintained at 90%. Plug flats can generally be removed from propagation after two to three weeks.

**Bulking**

*Phlox paniculata* cuttings should be bulked under noninductive photoperiods of 12 or 13 hours, depending on cultivar. The duration of bulking is dependent on the size of the finish pot. For a five-inch pot, three weeks of bulking at 68°F (20°C) is adequate.

**Vernalization**

Vernalization requirements vary by cultivar. Some *Phlox paniculata* cultivars, such as 'Mt. Fuji' and 'Tenor,' do not require a cold treatment for flowering. However, other cultivars such as 'Orange Perfection' and 'Blue Boy' require a cold treatment to flower. Five weeks at 41°F (5°C) is adequate for cold-requiring cultivars, and cold is not detrimental to cultivars that don't require cold. For production of multiple cultivars having different cold requirements, exposing all cultivars to cold may be the easiest strategy if cooling space is available.

**Forcing To Flowering**

*Phlox paniculata* should be grown under photoperiods of at least 14 hours, or with a four-hour night interruption, for rapid, uniform flowering. Most *Phlox paniculata* cultivars require about 11 weeks from the start of forcing to first flower at 68°F (20°C) (Figure 9). Some cultivars, such as 'Lilac Time,' 'Russian Violet,' and 'Tenor,' may only require 10 weeks at 68°F (20°C) to flower.

For forcing during low light periods of the year, supplemental lighting should be provided to improve plant quality. Total crop time from the start of propagation to first flowering for a five-inch pot is 16 to 17 weeks for noncold requiring cultivars and 21 to 22 weeks for cultivars that require cold (Table 1).

In our next article, we will provide quick-cropping plant specifics for *Leucanthemum x superbum* 'Snowcap,' *Veronica 'Red Fox,'* and *campanula 'Birch Hybrid.'

**About the authors:** Amy Enfield is a graduate student, Erik Runkle is an assistant professor, and Royal Heins, Art Cameron, and Will Carlson are professors, Department of Horticulture, Michigan State University, East Lansing, MI 48824. The authors would like to thank the research contributions of current and former greenhouse technicians David Joeright, Mike Olrich, and Dan Tschirhart, and the generous industry supporters who made this research possible.