Part 11 of our 14-part series on herbaceous perennials takes a look at the keys to successful quick-cropping.

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ONE of the problems associated with controlled forcing of herbaceous perennials is that the starting material can vary from crop to crop and year to year. In our experience, the variability has been greater for vegetatively propagated plants than for seed-propagated plants. Vegetatively propagated perennials are sold to growers in two forms - bare-root plants and rooted cuttings in plugs. Both forms offer different types of variability to the grower, such as flowering plugs (Figure 1) and disease and nonuniformity (Figure 2).

In this article, we describe concepts associated with the production of uniform, vegetatively propagated perennials in plugs based on principles of increased efficiency and reduced production time from propagation to sale.

Our approach has been to apply production techniques similar to those used for vegetative annual plugs, like using uniform and vegetative cuttings followed by the propagation and subsequent delivery of plugs programmed to rapidly flower by the grower.

A fundamental component for high-quality, uniform plugs is to take vegetative cuttings from properly managed, vegetative stock plants, and to maintain cuttings in the vegetative state until flowering is desired. A second fundamental part of this approach is to minimize the time required from sticking of the cutting until the plug, properly programmed to flower, is planted in the container for flowering (Figure 3). Because of this second fundamental principle, we call this the quick-crop perennial production system.

Our quick-crop perennial production system has five main phases: stock plant production and management, propagation, bulking (i.e., allowing plants to increase in mass), vernalization, and forcing to flower. The environmental conditions are optimized at each stage of production to make certain a quality, uniform flowering crop is ultimately produced. These five production phases are described below.

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Stock Plant Production And Management

The fundamental goal of stock plant management is to produce nonflowering cuttings. Successfully producing vegetative stock plants depends on our understanding of the flower induction processes for a particular perennial species. In our experiences, temperate herbaceous perennials fall mainly into three flower induction categories: day-neutral/cold required, photoperiodic (primarily long-day)/cold required, and photoperiodic/no cold required.

Plants that flower in response to photoperiod should be maintained under noninductive photoperiods to ensure that cuttings are vegetative. Because some perennials become dormant under short days, the photoperiod must be controlled to ensure stock plants neither go dormant from excessively short days nor prematurely flower from long days. For many long-day perennial species such as achillea and Phlox paniculata, a 12- or 13-hour photoperiod is optimum for maintaining vegetative stock, although there are exceptions. For example, Gaura lindheimeri must be maintained under photoperiods of nine hours or less to promote vegetative growth.

Some herbaceous perennials are day-neutral, meaning their flowering response is insensitive to photoperiod. These plant species generally require a cold treatment to flower. Day-neutral, cold-requiring plants usually bloom naturally in spring or early summer and then are vegetative until the following year. They grow vegetatively, regardless of photoperiod prior to vernalization and/or after flowering.

Perennial stock plants in this category, such as campanula ‘Birch Hybrid’ and many veronicas, can be maintained under natural daylengths, or even under long days if supplemental lighting is desired to increase cutting productivity.

Stock plants generally should be grown at moderate temperatures; 64°F to 68°F (18°C to 20°C) is sufficient. If plants are grown under high temperatures, growth can be weak and leggy,
and cuttings can be of low quality. If plants are grown too cool, growth slows and a longer time is needed between cutting harvests. During stock production, light quantity should be maximized within the ability to control greenhouse temperature to ensure high-quality cuttings.

Cuttings should be harvested whenever they are large enough (for many plants this is every four to five weeks), whether or not they are needed for production. Frequent harvests prevent the stock plants from becoming overgrown, and it also ensures continued branching and cutting production by the stock plants. Properly maintained, healthy stock plants that are disease- and insect-free produce healthy, clean, vegetative cuttings.

**Propagation**

As during stock plant management, a key to success during propagation is to prevent flower induction. It is important that plugs remain vegetative so plants can be accurately scheduled to flower. For plants that require a cold treatment for flowering, no particular photoperiod is required during propagation. However for photoperiodic plants, the daylength used in stock production should be used in propagation.

It is also important to use appropriate-sized plug trays and a high-quality porous media. A 50% peat/50% perlite mixture has worked well for us for most perennial species. The plug size used depends on the duration of bulk- ing, which is based primarily on the finished pot size.

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The use of a rooting hormone (e.g., 1,500-ppm liquid IBA dip) can help speed rooting and increase rooting uniformity. Plugs should be maintained under mist during the early stages of rooting. We maintain the soil temperature at 77°F (25°C) and air temperature at 73°F (23°C) during propagation, a combination that promotes rapid root formation without excessive shoot growth. We also maintain the vapor pressure deficit (VPD) at 0.3 kPa (90% relative humidity) throughout propagation.

If done correctly, cuttings are generally ready to be removed from propagation after 17 to 20 days.

**Bulking**

Once plants are removed from propagation, they are bulked (i.e., allowed to increase in mass) in the greenhouse to a size appropriate for the finish container size. During this phase, roots should become fully established and the plants should develop adequate size for forcing. Depending on space availability, bulking can occur in the plug flat or in the finish pot. During bulking, plants should remain vegetative, using photoperiod control when needed. Bulking duration varies with the final desired plant size, but for many species, two to four weeks is often sufficient.

A plug for a four-inch container will require less bulking than a plug intended for a one-gallon pot. The size of the plant at the end of bulking will often partially determine the final plant size at flower.

**Vernalization**

Part of the quick-crop perennial concept is to provide the minimum duration of cold necessary for flowering. The amount of cold required for complete and rapid crop flowering varies by plant species. Vernalization can be delivered using a cooler or natural cool temperatures in the greenhouse. For many cold-requiring species, four to six weeks between 32°F and 41°F (0°C and 5°C) is adequate to saturate a vernalization response. For example, a crop of veronica 'Red Fox' will flower completely and uniformly after five weeks at a constant 41°F (5°C).

During the vernalization treatment, plants should be vegetative; this means providing short days (generally a photoperiod of 8 hours). This period should be continuous, with no interruption of light. If done correctly, cuttings are generally ready to be removed from propagation after 17 to 20 days.

**Figure 3. Potential differences in production time between a traditionally propagated plug and quick-crop propagated plugs, all programmed for flowering in early June.**
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toperiod less than 12 hours) for long-
day plants. Some perennials do not re-
quire cold for uniform crop flowering,
including achillea 'Moonshine' and
some Phlox paniculata species.

Forcing To Flower

The final plant size at flowering has already been partially determined by
the size of the plants at the start of forc-
ing. At this stage of the production
cycle, plants are capable of flowing
either due to a previous vernalization
treatment, by photoperiod during forc-
ing, or both. If plugs have been kept
vegetative with temperature control
throughout propagation, bulking, and
vernalization, time to flower should be
predictable and uniform throughout
the crop. For the best quality and short-
est forcing time, it is best to force at
moderate temperatures, such as 64°F to
68°F (18°C to 20°C).

More Quick-cropping

We have demonstrated the quick-
crop perennial concept for six
herbaceous perennial species.
Starting next month, we will provide
a series of articles defining the
specifics for fast-cropping of Gaura
lindheimeri 'Whirling Butterflies,'
achillea 'Moonshine,' Phlox panicula-
ta 'Mt. Fuji,' Leucanthemum x super-
bumb 'Snowcap,' veronica 'Red Fox,'
and campanula 'Birch Hybrid.'

In general, a long-day photoperiod
(14 hours or greater provided by day-
extension lighting) or night interrup-
tion lighting (four hours from 10 p.m.
to 2 a.m.) is suitable for plants requir-
ing long days to flower. No photoperi-
od control is necessary for day-neutral
plants following vernalization.

During low-light periods of the year,
supplemental light should be provid-
ed to improve plant quality.

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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
Schroth, and the generous industry sup-
porters who made this research possible.