Gaillardia:
Unique Forcing Requirements Of Old And New Cultivars

This article highlights the flowering requirements of the vibrantly hued gaillardia cultivars, which have recently reclaimed the limelight. Growers interested in successfully producing flowering potted gaillardias should keep reading.

By Sonali Padhye, Catherine Whitman, Arthur Cameron and Erik Runkle

Gaillardia adorns its native North and South American habitats and cultivated gardens with daisy-like flowers of red and yellow, which resemble vibrant-colored blankets created by American Indians. Hence, gaillardia has been given the common name of blanket flower. Gaillardia consists of more than a dozen annual and perennial species of which Gaillardia x grandiflora, a naturally occurring hybrid between Gaillardia aristata and Gaillardia pulchella, has been particularly popular in the past several years. This is at least in part due to its perennial lifecycle; cold hardiness to USDA Zone 4; heat, humidity and draught tolerance; vigor; and attractive flower color and form. Most commercially available perennial cultivars of gaillardia, including some discussed here, have Gaillardia x grandiflora in their genetic background. Although a short-lived perennial in the landscape, gaillardia continues to be popular and is widely used in flower beds and mixed containers.

In recent years, the introduction of exceptional new cultivars has brought gaillardia back into the limelight. In 2003, gaillardia ‘Sundance Bicolor’ was awarded the All American Award. Gaillardia ‘Arizona Sun’ is even more impressive and can be used alongside annuals to provide an instant splash of color in the garden with its non-stop flowering (Figure 1). It won both the All American and Fleuroselect awards in 2005. More recently, ‘Fanfare’, with its cool tubular petals, and ‘Oranges and Lemons’, with its continuous yellow orange flowers, have brought even more attention to this genus (Figure 2, below).

Cultivars
Hybridization between annual and perennial species of gaillardia has yielded an array of cultivars with attractive colors and forms, adaptability to diverse growing conditions, and an extended bloom season. The introduction of genes from annual species has decreased the lifespan of several cultivars, making many selections short-lived perennials in the garden. However, genes from annual species also have contributed to the non-stop flowering of many cultivars, attracting consumer interest.

We have evaluated traditional gaillardia cultivars with red- and yellow-colored flowers including ‘Goblin’, ‘Dazzler’, ‘Baby Cole’ and ‘Burgundy’. ‘Goblin’ has been rather popular over the years and requires vernalization treatment and long days for synchronized and complete flowering. ‘Baby Cole’ is shorter, while ‘Dazzler’ is taller than ‘Goblin’. We’ve also experimented with newer red and yellow flower introductions, including ‘Arizona Sun’, ‘Galileo’ and ‘Gailarus’. As its name suggests, ‘Burgundy’ has maroon inflorescences. The color pallet of gaillardia has been broadened by the introduction of peach and apricot flowers of ‘Oranges and Lemons’ and ‘Summer’s Kiss’. ‘Fanfare’ has tubular ray flowers and is a favorite among consumers.
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Our floriculture research group at Michigan State University (MSU) has performed research to identify the flowering requirements of several new and old gaillardia cultivars. This article highlights our findings and provides information for successful production of flowering potted gaillardia.

Like many temperate herbaceous perennials, the flowering of many gaillardia cultivars requires exposure to low temperature, also known as vernalization treatment, as well as exposure to a long photoperiod. During our experiments, we have recorded significant differences in vernalization and photoperiodic requirements of gaillardia cultivars (Table 1). Hence, to successfully force a gaillardia cultivar for a scheduled market date, it is essential to consider its specific forcing requirements. Additionally, starting material often has a significant impact on vigor and flowering time and therefore should also be considered prior to forcing.

### Table 1. Research-based production information and flowering characteristics for select gaillardia cultivars.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Starting Material</th>
<th>Vernalization Response</th>
<th>Photoperiod for Flowering</th>
<th>Time Flower at 68° F</th>
<th>USDA Cold Hardiness Zone</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Arizona Sun'</td>
<td>128-cell seedlings</td>
<td>Facultative response. 15 weeks at 41° F hastened flowering by 2-3 weeks.</td>
<td>Facultative long (LD) plant. Under LD, flowering was hastened and buds and height were increased compared to short days (SD).</td>
<td>3 after 15 weeks of cold &amp; under LD</td>
<td>5-6 after 15 weeks cold &amp; under LD</td>
<td>3-8</td>
</tr>
<tr>
<td>'Dazzler'</td>
<td>128-cell seedlings</td>
<td>Unknown. All plants were cooled for 15 weeks.</td>
<td>Facultative LD plant. Faster to flower, more flowers, taller under LD.</td>
<td>-</td>
<td>-</td>
<td>3-10</td>
</tr>
<tr>
<td>'Gailarus'</td>
<td>Vegetative cuttings</td>
<td>Facultative response. Cooling for 3-15 weeks hastened flowering under SD. Cooled plants had more flower buds under SD and LD.</td>
<td>Facultative LD plant. Plants under SD were shorter, had fewer buds and flowered later than LD plants.</td>
<td>5-7 after ≥3 weeks at 41° F &amp; LD forcing</td>
<td>6-7 after ≥6 weeks at 41° F &amp; LD forcing</td>
<td>During cooling, several leaves died in the cooler and at forcing plants quality was poor for 2-3 weeks. However, plants subsequently recovered. Flowers fairly similar to that of 'Arizona Sun'.</td>
</tr>
<tr>
<td>'Galileo'</td>
<td>Vegetative cuttings</td>
<td>Facultative response under LD and obligate under SD. 3-15 weeks at 41° F hastened flowering under SD. ≥3 weeks at 41° F recommended for LD force.</td>
<td>Obligate LD without vernalization treatment and facultative LD following vernalization treatment. After 15 weeks at 41° F, flowering under SD was incomplete and delayed.</td>
<td>4-5.5 after ≥3 weeks of cold &amp; under LD</td>
<td>7-9.5 after ≥3 week cold &amp; under LD</td>
<td>Flowers have red centers like ‘Gailarus’ but more yellow on the petal tips. ‘Galileo’ rooted more easily and responded more strongly to photoperiod and vernalization treatments than ‘Gailarus’.</td>
</tr>
</tbody>
</table>

### Propagation

Depending on the cultivar, gaillardia can be
Table 1. (continued)

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<tr>
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<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Goblin’</td>
<td>Seed. Juvenility ends with ~16 nodes (leaves)</td>
<td>Facultative response. Vernalization treatment increased flowering percentage and uniformity and hastened flowering. 9-12 weeks at 41°F is recommended. Some plants flowered without a cooling treatment.</td>
<td>Facultative LD plant. Plants flowered without cold but were slower to flower, had fewer flowers and were shorter.</td>
<td>3</td>
<td>6.5</td>
</tr>
<tr>
<td>‘Fanfare’</td>
<td>Tissue culture</td>
<td>No response.</td>
<td>Facultative LD. Flowering time was similar under SD and LD but more buds under LD.</td>
<td>1-2</td>
<td>5-6</td>
</tr>
<tr>
<td>‘Oranges and Lemons’</td>
<td>Vegetative cuttings</td>
<td>No response.</td>
<td>Facultative LD. Flowering slightly delayed under SD and plants shorter with fewer buds under SD.</td>
<td>3-4</td>
<td>4.5-6</td>
</tr>
</tbody>
</table>

Table 1. (continued)

propagated by seed, shoot-tip cuttings, division or tissue culture. Similar to many other herbaceous perennials, seed-propagated cultivars such as ‘Goblin’ and ‘Arizona Sun’ were more variable in their flowers and flowering compared to vegetatively propagated cultivars such as ‘Fanfare’ and ‘Gallarus’. In some cultivars, providing inductive treatments such as long days may reduce (but not eliminate) the variability in flowering time associated with seedlings. For example ‘Arizona Sun’ was highly variable in flowering time when plants were forced under a 9-hour photoperiod, while a 16-hour photoperiod induced more uniform flowering.

Although vegetatively propagated gaillardia cultivars are more uniform than seedlings, a potential challenge with them can be maintaining vegetative stock plants and liners until forcing begins. This is particularly an issue with continuously flowering cultivars such as ‘Oranges and Lemons’ that generally do not require vernalization for flowering. Under long days, stock plants flower and thus cuttings are reproductive. Under short days, few cuttings are produced because plants remain as a rosette. Also, liners that are rooted and bulked under long photoperiods can flower sporadically in the plug tray.

**Juvenility and Bulking**

During the juvenile phase, seedlings remain vegetative and do not respond to inductive treatments such as vernalization or long...
crop cultivation

Gaillardia ‘Arizona Sun’

0 weeks at 41°F
11 weeks forcing at 68°F

15 weeks at 41°F
6 weeks forcing at 68°F

Vernalization

Vernalization is defined as the promotion of flowering following a cold treatment. The cooling treatment itself is sometimes called a vernalization treatment. Some cultivars require vernalization for flowering and thus have an obligate vernalization response. Other cultivars have a facultative vernalization response, where vernalization can accelerate flowering, improve flowering characteristics such as higher flowering percentage, synchronize flowering and increase flower number.

The vernalization response of gaillardia is highly cultivar-dependent and ranges from no response to an obligate response, depending on the photoperiod (Table 1, pages 22 and 23). For example, a 15-week vernalization treatment at 41°F did not influence the flowering time or flowering characteristics of ‘Fanfare’ and ‘Oranges and Lemons’. In contrast, ‘Arizona Sun’, ‘Gailarus’, and ‘Goblin’ exhibited a facultative response, and their flowering was accelerated by a vernalization treatment. ‘Gallileo’ required vernalization to flower when forced under a 9-hour photoperiod and had a facultative vernalization response when forced under a 16-hour photoperiod.

In many cultivars, the magnitude of acceleration of flowering by a vernalization treatment depended on the forcing photoperiod. For instance, a vernalization treatment at 41°F for 15 weeks hastened flowering of ‘Arizona Sun’ by 2-3 weeks when forced under a 16-hour photoperiod.

To maintain the aesthetic appeal of gaillardia produced for large-sized final containers, it is important to allow plants to bulk up to size before forcing. Also, if some of the plugs have flower buds upon receipt, their removal prior to forcing is beneficial to ensure synchronized flowering.

Photoperiods. Typically, plants become mature and capable of flowering once they have grown a certain number of leaves. This leaf number varies among species and cultivars. For example, research at MSU found that the juvenile phase of ‘Goblin’ ends after the plant has unfolded about 16 leaves. Hence, ‘Goblin’ seedlings need to be bulked under short photoperiods until at least 16 leaves are present prior to providing vernalization or photoperiod treatments. In our evaluations, ‘Arizona Sun’ seedlings required vernalization to flower, whereas ‘Gallileo’ and ‘Oranges and Lemons’ did not exhibit juvenility and flowered uniformly when provided with a vernalization treatment followed by long days.

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**Crop Cultivation**

Gaillardia ‘Oranges and Lemons’

<table>
<thead>
<tr>
<th>Photoperiod</th>
<th>Percent Flowering</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD 0 weeks at 41° F</td>
<td>100</td>
</tr>
<tr>
<td>6 weeks forcing at 68° F</td>
<td>100</td>
</tr>
<tr>
<td>LD-INC</td>
<td>100</td>
</tr>
<tr>
<td>LD-HPS</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 5. Although gaillardia ‘Oranges and Lemons’ flowered completely under short days (SD) or long days (LD), plants under SD formed rosettes and had fewer flowers and branches. Hence, horticulturally ‘Oranges and Lemons’ can be considered a LD plant. Note that plants grown under high pressure sodium lamps (LD-HPS) were more compact and had more branches and buds than those under incandescent lamps (LD-INC).

Photoperiod

Similar to many photoperiodic herbaceous perennials from temperate origins, most gaillardia cultivars are long-day plants and flower when the photoperiod exceeds a critical value, typically 12-13 hours (Figure 4, page 24). Gaillardia typically respond facultatively to long days and flower faster and/or have improved flowering characteristics when forced under long days, including more uniform flowering, increased flowering percentage, and more flowers and flowering laterals.

Although many cultivars do eventually flower when grown under short days, the plants are excessively compact and form rosettes with few flowers (Figure 5, left). Therefore, we consider most gaillardia to be obligate long-day plants and recommend a photoperiod greater than 13 hours during forcing. To achieve this, long-day lighting is required in North America from mid-September through early April. Long-day lighting can be provided as a 4-hour night interruption or day extension. When providing long day lighting for forcing gaillardia, plants tend to stretch under incandescent lamps and hence, may require more liberal use of plant growth regulators to control stem extension.

Light Quantity

Gaillardia is a sun-loving perennial and becomes rather floppy when grown under shade in the garden. Similarly, gaillardia thrives under high light in the greenhouse and produces weaker stems when grown under lower light. When provided with supplemental light, gaillardia cultivars were more compact and produced more branches and flowers in our trials (Figure 5). To produce high-quality gaillardia, the average daily light integral in the greenhouse should exceed 10 mol·m⁻²·d⁻¹.

Regulating Plant Growth

Many gaillardia cultivars are unruly and floppy when grown under low light levels, and plants elongate excessively when long day lighting is provided by incandescent lamps. Among various factors to consider for plant growth regulation of gaillardia, cultivar selection is of particular importance. In our trials, ‘Gailaras’ and ‘Galileo’ were appropriate for 5½-inch containers when forced without plant growth regulator applications (Figure 6, oppo-
polar graph of light output comparison

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Summary

Gaillardia cultivars comprise a group of great garden plants and can be used in combination with annuals and perennials for nonstop color through the summer. Similar to their flower colors and forms, the regulation of flowering varies among Gaillardia cultivars. ‘Goblin’ and ‘Arizona Sun’ facultatively respond to a vernalization treatment, whereas ‘Oranges and Lemons’ and ‘Fanfare’ do not require vernalization. Most gaillardia cultivars are horticulturally long-day plants, and thus a photoperiod longer than 13 hours is recommended for rapid and uniform flowering. We’ve been impressed with the new introductions of gaillardia and anticipate more exciting introductions from breeders in the near future.

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