

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 life cycle; 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



Figure 1. It is not uncommon to observe gaillardia planted alongside annuals because of their profuse and continuous flowering, as seen here in the Michigan State University trial gardens.

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. ◆



Figure 2. Unique yellow-orange flower color of gaillardia 'Orange and Lemons' (left) and exceptional tubular petals of gaillardia 'Fanfare' (right).

AC3829
CAPRI® CARD

Merry Christmas

#63
DESIGNER ENVELOPE



holi- dazzle!

#56 DESIGNER ENVELOPE

Season's Greetings

AD5215 HORIZONS® CARD

NEW!

BRIGHT LIGHT
Poinsettia

BB5022
TUF-TAG™



SL4269
HOLI-DAZE
6" POT COVER

Showcase your
holiday plants with
coordinated
containers, care
tags & gift cards.

Tuf-Tag™

Newly redesigned, our patented, fade-resistant Tuf-Tag™ is made of soft, flexible plastic that holds up in wet or humid conditions

Enclosure Cards & Envelopes

Choose from a variety of holiday sentiments and coordinating envelopes

Containers

Trend-forward designs and colors will dress up all of your holiday plants

866.378.7535

FAX 800.968.2598 OR VISIT

www.jhc.com



JOHN HENRY
experience by design™

A MULTI PACKAGING SOLUTIONS COMPANY

Write in 225

crop cultivation

Cultivar	Starting Material	Vernalization Response	Photoperiod for Flowering	Time Flower at 68° F		USDA Cold Hardiness Zone	Comments
				Weeks to VB	Weeks to Flower		
'Arizona Sun'	128-cell seedlings	Facultative response. 15 weeks at 41° F hastened flowering by 2-3 weeks.	Facultative long day (LD) plant. Under LD, flowering was hastened and buds and height were increased compared to short days (SD).	3 after 15 weeks of cold & under LD	5-6 after 15 weeks cold & under LD	3-8	Nice flower color and non-stop flowering in the garden. Variability associated with seedlings was observed.
'Dazzler'	128-cell seedlings	Unknown. All plants were cooled for 15 weeks.	Facultative LD plant. Faster to flower, more flowers, taller under LD.			3-10	Fewer flowers under SD. Plants look similar to 'Goblin' but taller.
'Gailarus'	Vegetative cuttings	Facultative response. Cooling for 3-15 weeks hastened flowering under SD. Cooled plants had more flower buds under SD and LD.	Facultative LD plant. Plants under SD were shorter, had fewer buds and flowered later than LD plants.	5-7 after ≥3 weeks at 41° F & LD forcing	6-7 after ≥6 weeks at 41° F & LD forcing		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'.
'Galileo'	Vegetative cuttings	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.	Obligate LD without vernalization treatment and facultative LD following vernalization treatment. After 15 weeks at 41° F, flowering under SD was incomplete and delayed.	4-5.5 after ≥3 weeks of cold & under LD	7-9.5 after ≥3 week cold & under LD		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'.

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

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.

Propagation

Depending on the cultivar, gaillardia can be

Helping Your Business Grow!



From cold frames to free-standing greenhouses to gutter connects - Atlas has you covered!

Simply the **BEST** greenhouse for your dollar!



- ⇒ Low Prices
- ⇒ Customized Sizes
- ⇒ Most Orders Ship in 3 Days
- ⇒ In-house Engineering
- ⇒ Financing Available

Color Catalog with Pricing 1-800-346-9902 www.atlasgreenhouse.com

Write in 753

Hit Pay Dirt!

PARKER DAVIS Co., Inc.
presents
Affordable, Heavy-Duty Nursery Marker Stakes

STEP STAKES®

Ideal for wholesale and retail nurseries, growers and garden centers, our patented nursery marker stakes are made to last for years and offer the most durable economic choice on the market today.

- 9-gauge galvanized steel
- 8, 16, 24, 32, and 48 inch lengths
- Top and bottom bend for upright card display and use with flats and pots
- Corrugated polypropylene cards in eight colors for easy signage color-coding (sun/shade, species, prices, etc.)
- Three standard card sizes
- Can be used with any permanent marker or labeling system

6" w x 2 1/2" h Card

Only available in white

9 ga. x 2" x 8" Stake

7" w x 5 1/2" h Card

Corrugated plastic cards work well with computer generated labels.

9 ga. x 2" x 8" Stake

2 1/2" w x 6" h Card

9 ga. x 2" x 16" Stake

PARKER DAVIS Co., Inc.
2310 N. Tryon Street • Charlotte, NC 28206-2791
Visit our website at: www.parkerdavis.com
Fax 704-375-9116 • Phone 800-438-0387

For a price list and **FREE SAMPLE**, call **1-800-438-0387** today!

Write in 754

Cultivar	Starting Material	Vernalization Response	Photoperiod for Flowering	Time Flower at 68 °F		USDA Cold Hardiness Zone	Comments
				Weeks to VB	Weeks to Flower		
'Goblin'	Seed. Juvenility ends with ~16 nodes (leaves)	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.	Facultative LD plant. Plants flowered without cold but were slower to flower, had fewer flowers and were shorter.	3	6.5	4-8	Traditional cultivar that has large and showy red flowers with yellow rings. Can be highly variable in form and flowering. Deadheading is beneficial in the garden for continuous bloom.
'Fanfare'	Tissue culture	No response.	Facultative LD. Flowering time was similar under SD and LD but more buds under LD.	1-2	5-6	4-9	Very showy plants bloom non-stop in pots and gardens. Seed-heads are quite attractive and dead-heading not required for re-blooming.
'Oranges and Lemons'	Vegetative cuttings	No response.	Facultative LD. Flowering slightly delayed under SD and plants shorter with fewer buds under SD.	3-4	4.5-6	6-10	Very unique yellow-orange flower color. Plants flower non-stop in the garden and in containers. Seed heads are attractive and dead-heading not required for re-blooming.

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 'Gailarus'. 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

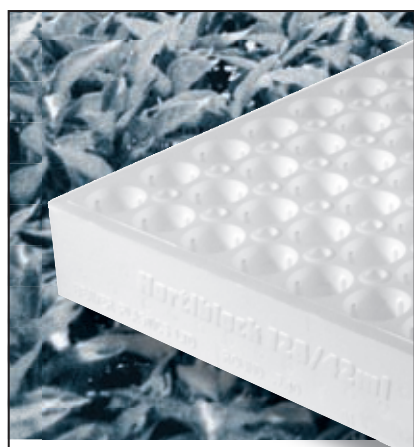
flowering time when plants were forced under a 9-hour photoperiod, while a 16-hour photoperiod induced more uniform flowering.

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



Growing year,
after year,
after year.



propagation tray manufacturer

1.888.453.5961

www.beaverplastics.com

Write in 755



MultiEVA Plastic Is Proven To:

- Improve Fuel Efficiency By 3-5%
- Eliminate Dripping
- Optimize Light & UV Transmission
- Be Extremely Durable

A Testimonial from Seacliff Greenhouses

"We have used many different greenhouse coverings over the years but we will only use MultiEVA in the future. Our greenhouses have never been so dry. Our flowers flourish under this plastic and our vegetable transplants now reach maximum maturity for the space utilized."

John & Bob Ondejko



Richard Colasanti, David Boutros or Adam Cervini

Ph: 519.326.6000 Fax: 519.322.4848 E-mail: sales@excaliburplastics.com
P.O. Box 459 Ruthven, Ontario N0P 2G0

www.excaliburplastics.com



Write in 756

crop cultivation

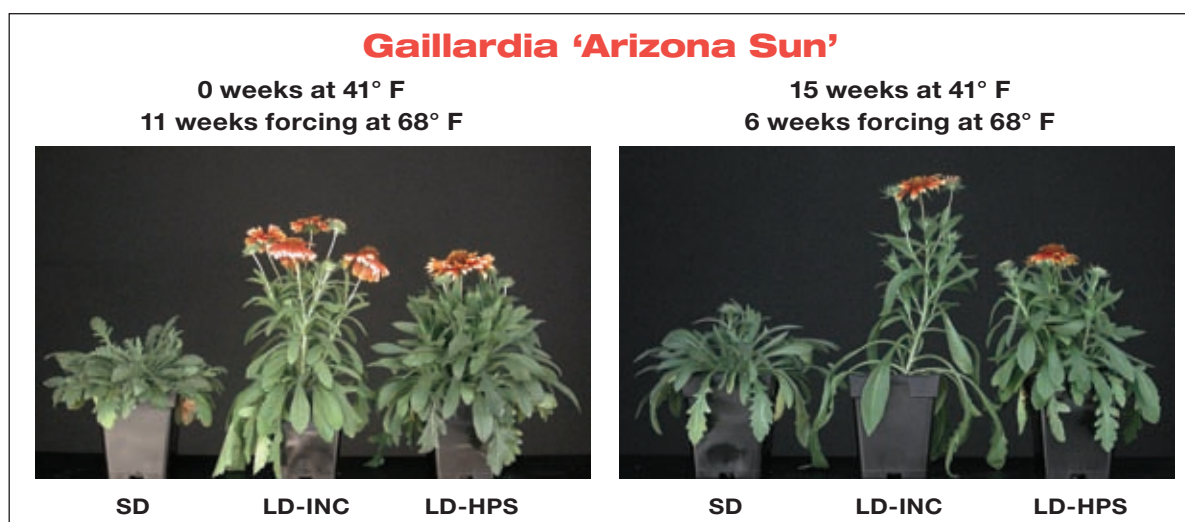


Figure 3. *Gaillardia* 'Arizona Sun' had a facultative vernalization response when cooled at 41° F for 15 weeks. Flowering was hastened by 6-7 weeks when vernalized plants were forced under a short day (SD, 9 hours), while when forced under long days (16 hours) provided by incandescent lamps (LD-INC) or high-pressure sodium lamps (LD-HPS), vernalized plants flowered 2-3 weeks earlier than non-vernalized plants.



Figure 4. The critical photoperiod of *gaillardia* 'Goblin' is between 12 and 13 hours. Note that the flowering percentage reported in the figure was recorded when the photograph was taken. More plants eventually flowered. Plant height at flowering generally increased with photoperiod.

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 had more than 10 leaves upon receipt. Therefore, it did not exhibit juvenility and flowered uniformly when provided with a vernalization treatment followed by long days.

To maintain the aesthetic appeal of *gaillardia* produced for large-sized final containers, it is

important to allow plants to bulk up to size prior to forcing. Also, if some of the plugs have flower buds upon receipt, their removal prior to bulking is beneficial to ensure synchronized flowering.

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. 'Galileo' 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

TESTED & PROVEN to be THE BEST.

Certified tests* of our
best selling e-system against
the competition prove it:

- 7% Less Energy Draw**
- 8% More Lumen Output**
- 10% More Reflector Efficiency**

* Testing performed by Arizona Lighting Sciences on 600W E-Series vs competitors 600W light fixture.

PARSOURCE THE COMPETITION

More Efficiency
7% Less Energy Draw Less Efficiency

More Light
8% More Lumen Output Less Light

More Reflectivity
10% More Light Reflected Less Reflectivity

More Warranty
5 Years Less Extensive Warranty

More Service & Support
More than 30 Years Experience Less Service & Support

Less Weight
Only 17 lbs. More Weight—Over 35 lbs.

Less Shadow New E-Series casts
the smallest shadow on the market More Shadows

a division of Hydrofarm

PARsource

lighting solutions

Up for the PARsource Challenge? Call to find out how
PARsource blows away the competition. We'll send a test for your greenhouse.
For details, call or email garth@parsource.com
For Certified Comparison Test Results, call 800-634-9990

Write in 757

For Info and Ordering, Call
1-800-635-4532

Speedy Seeder
(Vacuum Seeder)
Offers Many
Advantages

(Available with a Flip)

Easy to Use • Mounted Vacuum Seed Channel • Accurate Fast • Low Cost • Stainless Steel Construction • Seeds Melon to Raw Petunia, in cell pack or plug flats, in 10/20 and 13/26 flats • More efficient seeding.

Germination Chamber

Our Germination Chamber Enables You To Get Your seeds Off To A Faster Start. These Portable "Hot Houses" Feature Automatic Temperature Control • Stainless Construction • Polycarbonate Doors • Removable Doors and Shelves • Caster Wheels • Operates On Standard 110 Volt Outlet • Optional Water Reservoir Available.

ARRIVES FULLY ASSEMBLED & READY TO USE!!!

P.O. Box 1140 • Kinston, NC 28503
Phone: 252-523-9300 / Fax: 252-523-3691
www.carolinagreenhouses.com

Write in 758



— Gary Mangum — Co-Owner
Bell Nursery
Burtonsville, MD



Don't you deserve some V.I.G. treatment?

Plants are your livelihood and Fafard will treat you like the V.I.G. (Very Important Grower) that you truly are.

Fafard V.I.G.'s are privy to all the knowledge and resources we've gained in eight decades of hands-on horticulture. As insiders, they count on the partnering advantages and our traditions of:

- Consistent quality
- Exceptional value
- Testing in our in-house labs
- V.I.G. service and support (including custom mixes!)

Don't worry, there's no initiation rites or secret handshake to learn. But if you look closely, you can spot the Fafard V.I.G.'s. Their beautiful plants, happy customers and successful operations give them away every time.

**We understand your plants
AND your business.
Grow them better with Fafard.**

Fafard®

P.O. Box 790
Agawam, MA 01001

1-888-Grow Mix

Fax: 413-789-3425
Anderson, SC: 1-800-722-7645
Apopka, FL: 1-800-833-7645
Marshall, TX: 1-866-475-0019
sales@fafard.com
www.fafard.com



crop cultivation

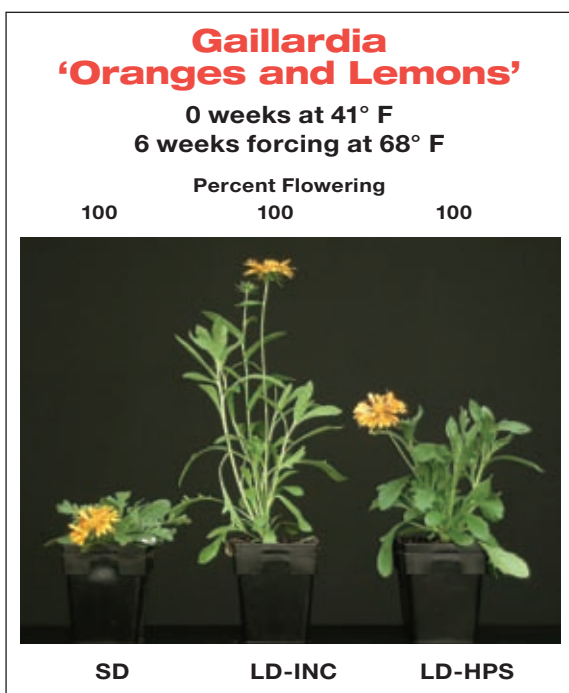


Figure 5. Although gaillardia 'Oranges and Lemons' flowered completely under short days (SD) or long days (LD), plants under SD formed rosettes and had fewer flowers and branches. Hence, horticulturally 'Oranges and Lemons' can be considered a LD plant. Note that plants grown under high-pressure sodium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

photoperiod at 68° F, but when plants were forced under a 9-hour photoperiod, vernalization hastened flowering by 6-7 weeks (Figure 3, page 24).

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, 'Gailarus' and 'Galileo' were appropriate for 5½-inch containers when forced without plant growth regulator applications (Figure 6, oppo-

Less is MORE

WE'VE REVOLUTIONIZED GREENHOUSE LIGHTING AGAIN!

Growers asked P.L. Light Systems for more light, less energy, easier maintenance and better crop performance. And we listened.

Our relationship with growers has resulted in the high efficiency HS2000. Engineered to burn brighter and consume less energy, the HS2000's slim revolutionary design and light weight also minimizes shadows and allows for quick, easy installation and maintenance. The highly efficient HS2000 achieves optimum results with fewer fixtures. So less really is more.

- | | | |
|-------------|---|----------------|
| Less energy | ✓ | More efficient |
| Less shadow | ✓ | More light |
| Less set-up | ✓ | More savings |
| Less heat | ✓ | More life |

P.L. Light Systems' innovative greenhouse lighting products are developed with direct input from growers.



P.L. LIGHT SYSTEMS
Member of HORTILUX SCHRÉDER GROUP

Call 1.800.263.0213 for more information or visit our website at www.pllight.com



'Gailarus'

'Galileo'

Figure 6. Gaillardia 'Gailarus' and 'Galileo' were compact and suitable for 5½ inch containers when forced without plant growth regulator applications.

site). In contrast, 'Oranges and Lemons' was too tall for 5½-inch containers when grown under a 16-hour photoperiod provided by incandescent lamps (Figure 5).

We have tested the effects of 100 ppm of A-Rest (ancymidol), 5,000 ppm of B-Nine (daminozide), 90 ppm of Bonzi (paclobutrazol), 1,500 ppm of Cycocel (chlormequat chloride) and 15 ppm of Sumagic (uniconazole) as foliar sprays on height control of 'Burgundy'. A-Rest was slightly effective, and B-Nine and Sumagic were highly effective at inhibiting stem exten-

sion. Sumagic also was effective in controlling the height of 'Fanfare'. We recommend growers conduct their own trials to determine effective plant growth regulator rates for their growing conditions and use graphical tracking to determine application time.

Summary

Gaillardia cultivars comprise a group of great garden plants and can be used in combination with annuals and perennials for non-stop 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. [GPN](#)

Sonali Padhye is post-doctoral research associate, Catherine Whitman is research technician,

Arthur Cameron is professor and Erik Runkle is associate professor and floriculture extension specialist in the Department of Horticulture, Michigan State University, East Lansing, Mich. Padhye can be reached at padhyeso@msu.edu.

The authors would like to thank the Metropolitan Detroit Flower Growers Association and the Western Michigan Greenhouse Association for financial support. We express our appreciation to C. Raker and Sons, Oro Farms, and Walter's Gardens for donations of plant material, Michigan Grower Products for donations of media, and The Blackmore Co. for fertilizer donations. We also thank Mike Olrich and undergraduate student employees in the Floriculture Program at Michigan State University for providing plant care.

LearnMore For more information related to this article, go to www.gpnmag.com/lm.cfm/gp090701

Reader Interest Review

Please write in the appropriate number on the Reader Service Card to indicate your level of interest in this article.

High 1500 Medium 1501 Low 1502



LightCare
from P.L. LIGHT SYSTEMS

Save Money on Energy!

At P.L. Light Systems, we take a scientific approach to saving you money on energy costs.

- Reflector efficiency testing and Reanodizing programs
- Lamp testing and relamping programs
- Service contracts and maintenance programs
- Comprehensive financial analysis

Call today and start saving money!

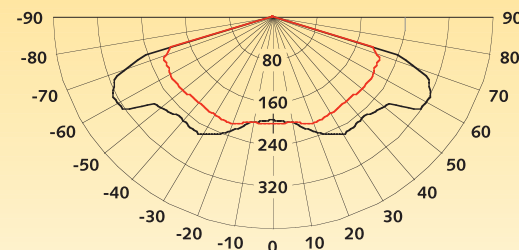
1.800.263.0213
or email lightcare@pllight.com

P.L. LIGHT CARE



The Ulbrich Sphere can test the lumen/PAR light output of any bulb.

GONIOPHOTOMETER READING



This polar graph shows the difference between a used PL94 Medium reflector and a re-anodized one. The red line shows that the used reflector is operating at 90.7% of the re-anodized reflector.

P.L. LIGHT SYSTEMS IS YOUR LIGHTING SOLUTIONS PARTNER