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# GUIDELINES FOR CUT FLOWER GROWERS

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Each color or variety is unique in its growth habit and performance. Our CALLAFORNIA CALLAS® Tech Sheets CD is available through your broker. The Tech Sheets also are viewable/downloaded from our website @ [www.goldenstatebulb.com](http://www.goldenstatebulb.com).

Highest quality and uniform calla culture requires special attention to media selection, water management and forcing temperatures, while employing a strong preventative fungicide program. Please read and follow these entire directions carefully. *The summary checklist of MUST DO'S are numbered 1 - 12 on page 8. However, proper culture is not limited to these twelve summarized points.*

**1 RECEIVING AND HANDLING OF DORMANT TUBERS:** Immediately unpack on arrival. **Dispose of any soft rot and wash hands to avoid spreading the bacteria to healthy bulbs. Place in well-ventilated trays at 65°F (18°C) for one to two days prior to planting to “heal off” any wounds that may have occurred in transit.** For long-term storage, keep well ventilated at 50°F (10°C); avoid excessive drying by keeping humidities at 80%.

**2 PRODUCTION ENVIRONMENT:  
OUTDOOR:**

Callas are semi-hardy and cannot take a hard frost. Though a light frost can be tolerated, the tuber will be destroyed if the ground freezes to the depth of the tuber.

In northern latitudes and California, open field-grown callas should naturally bloom from May to late July. Excellent soil drainage is critical. Later plantings, when soil temperatures approach 60°F (15.5°C), usually result in less loss due to bulb rot, but also later flowers. Earlier field plantings or established blocks can be plastic mulched or tunneled for earlier blooms. Trial for your environment.

**GREENHOUSE:**

As a general rule, the earlier in the spring (or winter) that callas are planted, the sooner they will bloom. However, the number of days between planting date and bloom decreases with later plantings as warmer temperatures and longer days accelerate growth.

Callas can be grown in raised beds or in containers. Great soil drainage is critical. Planting tubers in portable Dutch bulb crates works well. 4 - 8 tubers can be planted per 15 x 24" crate, depending on tuber size. The plants can be grown in a heated greenhouse for early spring flowering and moved outdoors for vegetative growth making greenhouse space available for another crop. Callas require 6 - 8 weeks of vegetative growth post flowering. Dormancy then requires another 8-10 weeks prior to regrowing.

**Though no exact scheduling techniques have been perfected yet for callas, here are some approximate forcing times when producing callas under temperature-controlled conditions.**

APPROXIMATE TIME TO FLOWER EXPRESSED IN WEEKS*				
(arranged in order of early to late flowering)				
CALLAFORNIA CALLA® CULTIVAR	JAN-FEB		MAR-MAY	
	FIRST FLOWER	PEAK (GA INDUCED) FLOWERING	FIRST FLOWER	PEAK (GA INDUCED) FLOWERING
LAVENDER GEM	8	9-10	7	8-9
RUBYLITE ROSE	9	10-11	8	9-10
SUPER GEM	"	"	"	"
GARNET GLOW	"	"	"	"
MINT JULIP (Crème de Mint)	"	"	"	"
CRYSTAL BLUSH	"	"	"	"
GOLD CROWN	"	"	"	"
GOLD RUSH	"	"	"	"
STRAWBERRY PARFAIT	"	"	"	"
REGAL	"	"	"	"
FIRE DANCER	"	"	"	"
TWILGHT	"	"	"	"
RUBY SENSATION	"	"	"	"
PARFAIT	10	11-12	9	10-11
FLAME	"	"	"	"
YELLOW HYBRID	"	"	"	"
SUNSHINE (Sunny)	"	"	"	"
FIREGLOW (Fireside)	"	"	"	"
BLAZE	"	"	"	"
PILLOW TALK	"	"	"	"
PINK GIANT	"	"	"	"
ALBO MACULATA (Little Jimmy)	"	"	"	"
MILLENIUM GOLD	"	"	"	"
SOLAR FLARE	11	12-13	10	11-12
BRIDAL BLISS	"	"	"	"
GOLDEN CHALICE	"	"	"	"

\*Larger and more sprouted calla tubers tend to bloom somewhat earlier than smaller tubers. Reduce average days to flowering by 5 days when using 2 ¼"-and-up-size tubers. For early plantings in dark and sub-optimal conditions, allow 2-3 weeks more time to reach peak bloom.

**3 TUBER TREATMENTS TO ENHANCE FLOWERING AND AID IN DISEASE PREVENTION: Progibb, the standard gibberellic acid (GA<sub>3</sub>) or Provide (GA<sub>4+7</sub>) or Promalin (GA<sub>4+7</sub> with benzyladenine) treatments all increase the number of flowers and reduce the time between first and second flowers.** Effect is greatest on gems and pinks, but GA is effective on yellows and whites to a lesser extent. A slight increase (5-10%) in flower deformation may occur on yellows and whites, but net gain in performance justifies its use. GA will increase plant height, slightly reduce leaf width, and soften stems, especially in low light and shorter days. Promalin tends to cause less flower deformities than Progibb.

To spray just lay the callas out “tops up” and spray to drip. Take care not to damage the sprout when handling. Try to get maximum coverage on all tubers. Allow tubers to dry slowly for at least 8 hours for maximum GA absorption.

**GA** should be added to the **spray mixture** at the following rates:

1. 1.8% Promalin\* solution: a 100 ppm GA<sub>4+7</sub>+BA mixture is 1.3 TBSP per U.S. gal H<sub>2</sub>O (5.5 ml/L)
2. 4% GA<sub>3</sub> solution (Progibb): a 125 ppm mixture is 0.8 TBSP per U.S. gallon H<sub>2</sub>O (3.1 ml/L)

**Note: The addition of a fixed copper such as Champ II at 1 oz. per gal. to the solution can help reduce pathogen pressure.**

*\*Promalin is the preferred compound over GA<sub>3</sub> as Promalin will not induce as many deformed flowers.*

**GSBG preconditioned tubers for new plantings are highly recommended to improve disease management and ensures optimal blooming & performance.**

**GA on Permanent Plantings:** GA can be drench applied to established plantings, without soil disturbance, prior to sprout emergence. A GA drench can be applied at the 100 ppm rate. The additional flowering effect will take 75-85 days. This method will increase flower yields and extend flower production, but, conversely, will decrease uniformity at harvest date as compared to the preconditioned, fresh planted bulbs.

Soil beds or containers can also be drenched with a 100 ppm GA solution if done during dormancy or within 5 days of initial watering of dormant bulbs. Soil should be moderately moist at time of drench to improve uniformity. Fungicides can be combined in the season's initial drench.

**4 PLANT HEALTH & GROWTH:** The *bacterial soft-rot syndrome*, which concludes with *Erwinia carotovora*, is generally preceded by water molds and *Rhizoctonia*. Other wounds or stresses also add to this profit-impacting pathogen complex. It is very important to follow media recommendations, use good sanitation practices and proper irrigation management, preventative drenches and temperature management. **In early forcing, most calla diseases are favored by overly wet and cold conditions. In summer growth, overly wet and excessively warm day and night conditions are also conducive to disease and soft rot. Follow our recommendations for well drained media with good air porosity, optimal fertility and salts management, as well as our preventative four-component fungicide drench program (addressing *Rhizoctonia*, *Erwinia* and water molds). See Drench section.**

**5 PLANTING AND SPACING:** Plant tubers 2" (5 cm) below surface, rounded side down. **Tilting larger tubers slightly encourages drainage off of the crown.** The spacing of tubers in the field, raised beds or containers depends on bulb size as well as whether they will be lifted in the fall.

RECOMMENDED PLANTING DENSITIES	
TUBER SIZE	ON CENTER (oc)
2-2¼" (16/18 cm)	9-11" (23-28 cm)
2¼-2½" (18/20 cm)	8-9" (20-23 cm)

**6 MEDIA:** The medium should be well drained and have a pH of 6-6.5. More drainage is required than for most cut flowers. Raised beds will aid drainage in heavier soils. **When using soilless mixes, callas are most successfully grown in a 35-50% peat medium.** The remaining percentage should consist of two or three parts of high draining materials such as coarse and graded perlite, fir bark, redwood shavings, vermiculite, lava rock or graded #2 or coarser sand. Sand also can act as ballast for top-heavy containerized plants. Recommended examples are as follows:

1. 40% peat moss, 25% perlite, 10% vermiculite, 25% fir bark

2. 33% peat moss, 33% perlite, 33% vermiculite.
3. 33% peat moss, 33% fir bark, 33% perlite

Trials with premixed media from leading brands indicate that media selection should be dictated by the need to hold peat levels down. *Callas don't like wet feet*. Though luxuriant growth is promoted by higher peat levels (over 50%), the resulting moisture levels also promote pathogens.

**Incorporation of gypsum and lime to the soil media** is worthwhile not only for pH adjustment, but for **calcium availability** and its relation to plant health. Incorporation of a Trichoderma biological such as Root Shield or Soil Guard at 0.75-1.0 lb/yd<sup>3</sup> (593gm/m<sup>3</sup>) help disease management. New biologicals are being newly registered and should be trialed with and without fungicide drenches prior to large scale use.

*A note on coco peat/coir:* Coir that is high quality and salt free has been used with mixed results. In cut flowers, some improvements in flower and stem quality have been observed. However, in pots, an overall greater incidence of water molds (pythium) has also been observed. Consequently, we do not recommend coir. If coir is incorporated, the grower does so at their own risk. If using coir despite our warnings, we strongly recommend strict adherence to our preventative drench program.

**7 WATERING: Proper water management is perhaps the most critical aspect of calla culture.**

After planting, a complete wetting, followed immediately by our 4-component fungicide drench, provides generally adequate moisture until the sprouts have emerged, especially in early, cool-season plantings. (See pesticide section on drenches). Then, without allowing plants to totally dry, water only moderately at least until foliage is full. **Even when growing rapidly, plants should not remain constantly wet since this can set the stage for root loss and subsequent erwinia.** Furthermore, avoid splashing water to reduce potential disease spread. Conversely, “dry” cultivation can negatively result in short stems and in severe cases can cause flower abortion and blindness. Note: occasional leaf spot phytotoxicity has been observed using overhead irrigation on bright, warm days, especially if using liquid feed, or using chemical drenches late in the evening where leaves never dry all night.

**8 TEMPERATURE & ENVIRONMENT:** When planting early (Dec.-Feb.) in greenhouses, start in 70-75°F (21-24°C) houses (or 70°F (21°C) bottom heat) until well emerged. Temperatures can then be dropped to 60°F (15.5°C) nights and 65-75°F (18-24°C) days. **Remember: cool soil temperatures, overwatering and moist, heavy soil delay flowering and can promote diseases.** Warmer temperatures speed flowering. If temperatures are lower, reduce watering. Callas require minimum light of 4000-foot candles or more. Stoutier stems and deeper coloration in pinks and many hybrid selections are achieved with high light and cool nights below 60°F (15.5°C). Under high temperatures and high light conditions 30-50% shade will help sustain optional growth and aid to lengthen stems.

**9 FERTILIZATION:** An early and aggressive balanced fertility is recommended to start plants off with a vigorous growth spurt and to deliver optimal final plant height and stature. Once sprouted and unfurling, fertility levels can be reduced by one half and later to one third of original concentration. As an example, begin with 300 ppm (Nitrogen) and graduate to 150 ppm, then later 100 ppm for flower flush. These recommendations apply to the temperatures mentioned earlier. Available calcium sources, such as calcium nitrate, may be preferentially considered as a potential aid to disease toler-

ance. Slow-release fertilizers incorporated or “top dressed” can be reasonably effective, but can release too quickly under warmer temperatures. Maintain EC levels of 1.5-2.0. Avoid EC levels of 2.5 or above. Leach media with clear water every 5<sup>th</sup> irrigation and especially during the last six weeks of the production cycle.

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## **FUNGICIDE DRENCHES AND PESTICIDES:**

**DISEASE CONTROL AND PLANT HEALTH:** Achieving or maintaining quality plants for the entire length of the crop requires cultural practices focusing on preventative control of diseases. Once established, diseases are difficult to control. Bulb stocks are field grown and every effort is made to ship healthy bulbs. Golden State Bulb Growers’ proprietary synergistic preconditioning treatment is highly recommended and we consider it essential as the first step to disease prevention. Success in disease management is dependent on controlling three (3) primary pathogens that independently or in concert can cause root and/or bulb rot. These are Rhizoctonia, Erwinia, and the water molds, known as Pythium and Phytophthora. Not one or even two products can successfully control all of these pathogens, and controlling only a portion of this pathogen complex can sometimes lead to worsening of the other untreated pathogens. Product registrations and availability vary by locale, but our best recommendations or their alternatives must be followed to address each pathogen group. Media incorporation of the biological control Trichoderma is also recommended as Root Shield @ 1 lb/yd<sup>3</sup> (593gm/m<sup>3</sup>) or Soil Guard (Gliocladium is related to Trichoderma) @ 12 oz/yd<sup>3</sup> (445gm/m<sup>3</sup>). These are compatible with most fungicides and can help maintain healthy roots. Although less effective than incorporation, these biologicals can also be drenched at planting at 8oz/100 gal (60 gm/100L) but should not be used as a substitute for a preventative fungicide drenching. Use of Zero Tol (hydrogen dioxide 27% ai) at a **RATIO** of between 1:1000 and 1:3000 for algae growth in constant feed also helps manage pathogens. Other biologicals can be effective and compatible with our fungicide drenches, but must be trialed prior to general use.

**Our best four-part tank mix chemical recommendations for drenches** are: for water molds, Subdue Maxx (mefenoxam 25.1% ai) @ 0.5-1 fl oz/100 gal (4-8 ml/100L) and Aliette (fosetyl-aluminum 80% ai) @ 13 wt oz/100 gal (98 gm/100L); for Rhizoctonia, Heritage (azoxystrobin 50% ai) @ 4 oz/100 gal (30 gm/100L); and, for the Erwinia bacterium, use Agrimycin-17 @ 8-16 wt oz/100 gal (60-120 gm/100L). The above components have been found superior at Golden State Bulb Growers relative to the labels registered in California, but all may not be available in your region. See our "Three Pathogen Calla Fungicide Drench Chart" below for these primary recommendations and other, lesser alternatives, should these not be available. Callas tend to be tolerant to chemical phytotoxicity. Trial other fungicides first on a small basis if these recommendations are not labeled in your locale.

The Erwinea bacterium, leading to bulb soft rot, is best controlled with Agrimycin-17 (Streptomycin sulfate 21.2% ai) at 8-16 wt oz /100 gal (60-120 gm/100L). Alternatives for bacterial control are few and, therefore, GSBG's standard Bulb Preconditioning using fixed copper is essential. As drenches, these fixed coppers are root phytotoxic. Therefore, drenching of another agricultural antibiotic (at label rates) or use of soluble copper Phyton-27 (copper sulfate pentahydrate 21.4% ai) at 13-20 fl oz/100 gal (100-156ML/100L) can help. See chart for recommendations and alternatives.

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**DRENCH TIMING:** Drench timing is critical since disease control is primarily preventative. Drench the first time within 2 days of planting and no later than 4 days from initial watering. Timing of the second drench is important and should be made at 14 to 21 days after planting. A third drench is recommended for 21-28 days after the second one (day 40-47 from planting), but may only be necessary if weekly root inspections reveal cleared or browning roots.

**Three Pathogen  
Calla Fungicide Drench Chart**  
All rates below are recommendations per 100 gal  
( ) indicates they are per 100 liters

<b>(1) <u>ERWINIA</u></b>	<b><u>RATES</u></b>
✦ Agrimycin-17 (streptomycin sulfate 21.2% ai) <i>powder</i>	8-16 oz/100 gal. (60-120 gm/100 L)
Phyton-27 (copper sulfate pentahydrate 21.4% ai) <i>liquid</i>	13-20 oz/100 gal. (100-156 ml/100 L)
<b>(2) <u>WATER MOLDS</u></b>	
✦ Subdue Maxx (mefenoxam 25.1% ai) <i>liquid</i>	0.5-1 oz/100 gal. (4-8 ml/100 L)
✦ Aliette (fosetyl-aluminum 80% ai) <i>powder</i>	13 oz/100 gal. (98 gm/100 L)
Terrazole (Etridiazole 35% ai) <i>powder</i> ***	4-6 oz/100 gal. (30-45 gm/100 L)
<b>(3) <u>RHIZOCTONIA</u></b>	
✦ Heritage (azoxystrobin 50% ai) <i>powder (also Pythium control)</i>	4 oz/100 gal. (30 gm/100 L)
Prostar (flutolanil 70.0% ai) <i>powder</i>	3-6 oz/100 gal. (22.5-45 gm/100 L)
Medallion (fludioxonil 50% ai) <i>powder</i> **	2 oz/100 gal. (15 gm/100 L)
Compass (trifloxystrobin 50% ai) <i>powder</i>	5 oz/100 gal. (37 gm/100 L)
3336 Clearys (thiophanate methyl 46.2% ai) <i>liquid</i>	20 oz/100 gal. (156 ml/100 L)
26019 Chipco ((iprodione 50% ai) <i>powder</i>	6.5 oz/100 gal. (49 gm/100 L)
✦ <b>Primary recommendation four-part tank mix</b>	
** Especially in Terrazole, and to a lesser extent in Medallion, we have very effective pathogen controls. However, some delay (3-6 days) in early growth, under sub-optimal conditions, has been observed. For these reasons, we have removed these two effective materials from our first and primary drench recommendations.	
*** <u>Aliette lowers pH and may cause phytotoxicity in combination with coppers in a drench on foliar application.</u>	

If any of these products are not available in your locale, then address the three major pathogens comprehensively with the best products available. Consult your local farm advisor. Callas tend to be tolerant of most products and we encourage experimentation (and record keeping) with new products biologicals or combinations on a trial basis. One such promising new product is the nutritional supplement potassium silicate, called Pro-Tekt (a Dyna-Gro product); which, in our trials, has demonstrated immune supportive benefit.

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**INSPECT CROP WEEKLY** for cleared or browning roots and be sure to redrench as above if root problems are discovered. These chemicals will lose their effectiveness with time. The same is true of Trichoderma. For this reason, repeat drench with Trichoderma at 21-28 days and, if necessary, near day 42 as well.

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**FLOWER AND LEAF SPOT:** As leaves unfurl, watch for leaf spot, and, if present, spray foliage with Champ II (copper hydroxide 37.5%) at 1-2 qt/100 U.S. gal. (2.5-5.0 ml/L) plus Dithane (mancozeb) at 1 qt/100 U.S. gal. (2.5ml/L) or Chipco 26019 @ 1 lb/100 U.S. gal. (1.2 g/L). Alternate with Daconil @ 1 qt per 100 gal (see label). Reduce guttation leaf-tip water droplets by modifying greenhouse environment and ventilation. Guttation droplets can sometimes result in small necrotic spots due to salt concentrations along leaf margins, especially during times of high temperatures, overly dried media and excessive fertilizer release with temperature-dependent slow-release fertilizers, or a lack of the recommended clear-water leachings, especially for production in pots.

Initial leaf tip or shoot clearing at emergence, we refer to as “**vidrio**” (plants generally grow out of this). However, this lack of chlorophyll when found in winter, northern latitude forcing, can lead to foliar disease in dark, humid conditions and must be treated as above immediately to prevent worsening of disease. Improve ventilation if possible.

NOTE: Some phyto spots can occur using overhead irrigation on bright warm days, particularly if liquid feed is used.

**14** **SANITATION:** Always remove diseased plants from the greenhouse or field area. Sanitation is critical, especially in multiple cropping programs where rot can progress without an obvious cause. Between crops, sanitize benches, floors, conveyors, containers, soil mixers, etc. See also control of Fungus Gnats and Shoreflies below. Consider soil fumigation/sterilization between crops in beds if disease is severe or worsening.

**15** **INSECTS:** Control aphids, thrips, shoreflies and fungus gnats (shoreflies and fungus gnats can spread bacteria; thrips and aphids spread virus): Orthene, Diazinon, Malathion, Tempo, Dursban, Maverik, Conserve, Endeavor and Marathon, for example, have been shown effective and non-phytotoxic. (Gnatrol and Exhibit are also very effective on fungus gnat larvae.) Check registrations in your area. Follow label rates. Callas tend to be tolerant to phytotoxicity of most sprays. Do small trials on new chemicals.

**16** **HARVESTING FLOWERS:** Pick flowers when the spathe is 3/4 to fully open and prior to pollen shed. Pollen shed usually occurs 4-7 days after flower is fully open. Flowers can be picked either by pulling stems or by cutting stems. There are advantages and disadvantages to both techniques. Pulling stems increases stem length and is a much quicker technique. Place hand at base of stem and pull sharply. However, some research shows that younger flower primordia can be damaged this way and stem “stretching” or bruising can take place if picking is not done correctly. Adequate soil moisture is necessary to avoid stem stretching when pulling.

Cutting stems reduces chance of flower primordia damage as well as stem stretching. However, the procedure takes more time, especially, if the harvesting tool is to be sterilized between cuts to avoid potential spread of virus. Note: the resulting stem length can be considerably shorter.

**17** **POST HARVEST HANDLING:** After picking, the flowers should be re-cut and graded. They should be put in a solution of flower preservatives but absent of sugars. This will reduce stem splitting and post harvest diseases.

Flowers should be stored at 35-39°F (2-4°C) if possible. Stems should be re-cut and solutions changed every two days, if not daily.

*NOTE: When bunching, do not bunch too tightly or solution uptake will be restricted.*

**These instructions are not a prescription or guarantee, nor are they recommendations or endorsements of any of the chemicals mentioned.**

# MUST DO STEPS

- 1) Order only Preconditioned Callaifornia Calla<sup>®</sup> Tubers. If purchasing non-GA'd/"Not Preconditioned" tubers, follow new recommendations for disinfectant and GA spraying.
- 2) Sort and air dry bulbs before planting.
- 3) Plant with only 2" (5 cm) of media covering tuber.
- 4) Use well-drained media with good porosity. (Incorporation of Trichoderma or other trialed biologicals is beneficial).
- 5) Follow optimal temperature regimes by stages.
- 6) Follow proper water management recommendations.
- 7) Follow fertility recommendations and avoid ammonium forms of nitrogen. Clear water leach every third to fifth irrigation.
- 8) Drench within 4 - 6 days of planting "preconditioned" tubers using the chemical combinations mentioned.
- 9) Re-drench with our recommended strong preventative program day 14 to 21 and again day 40-47.
- 10) Maintain greenhouse and field sanitation.
- 11) Control, fungus gnats, shoreflies, chewing larvae, as well as thrips and aphids, to reduce virus spread. Additionally, control leaf & flower spot to avoid pathogen spread and flower blemishes.
- 12) Change cut flower water solution and use "sugar free" preservatives, daily or on alternate days.