

GUIDELINES FOR POT GROWERS



Each color or variety is unique in its growth habit and performance. Our CALLAFORNIA CALLAS® Tech Sheet CD is available through your broker. The Tech Sheets can also be viewed/downloaded from our website @ www.goldenstatebulb.com / www.callaiforniacallas.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 9. However, proper culture is not limited to these twelve summarized points.*

1

TUBER TREATMENTS TO ENHANCE FLOWERING AND AID IN DISEASE PREVENTION:

Standard gibberellic acid, Progibb (GA₃) or Provide (GA₄₊₇) or Promalin (GA₄₊₇ with benzyladenine) treatments increase the total number of flowers per tuber. Generally, you can expect twice as many flowers with a GA treated tuber than with an untreated tuber. GA will slightly increase plant height, slightly reduce leaf width, and soften tissues, especially in low light and shorter days and in combination with high N fertilization. Subsequent Bonzi (paclobutrazol) application minimizes these effects. Order "PRECONDITIONED" TUBERS if you want tubers already treated with gibberellic acid plus disinfectants. (Note: Golden State Bulb Growers' preconditioning treatment includes the combination of a proprietary synergistic blend of fungicides/bactericides with the addition of the best GA formulation selected for each cultivar.)

Most growers request that Golden State Bulb Growers (GSBG) precondition their Callaifornia Callas' prior to shipment. This saves growers considerable handling, reduces disease and justifies the small additional charge.

~~For non-preconditioned tubers, GA plus fungicides may be applied to tubers with a backpack sprayer. Avoid tank dipping to reduce possible pathogen spread.~~

~~If you purchase "NOT PRECONDITIONED" callas, your tubers should be sprayed for thorough coverage with a fixed copper solution of copper hydroxide 37.5% (Champ II flowable) at 3 Tbsp/U.S. gal. (20 ml/L OR copper oxychloride 50WP at 0.4 oz/U.S. gal. (3 gm/L) plus Promalin at 100 ppm OR GA₃ (Progibb) at 125 ppm. For dipping, reduce Promalin to 75 ppm OR GA₃ to 100 ppm. Adding a fixed copper disinfectant to the GA solution will help control pathogen spread and reduce soft rot. The mixture must be agitated regularly. Allow to air dry, without fanning, over several hours for full effectiveness of the materials prior to planting.~~

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

- ~~1. 1.8% Promalin* solution: a 100 ppm GA₄₊₇+BA mixture is 1.3 TBSP per U.S. gal H₂O (5.5 ml/L)~~
- ~~2. 4% GA₃ solution (Progibb): a 125 ppm mixture is 0.8 TBSP per U.S. gallon H₂O (3.1 ml/L)~~

~~*Promalin is the preferred compound over GA₃ as Promalin will not induce as many deformed flowers.~~

2

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 a couple of days prior to planting. This will insure that any possible friction wounds caused by transit are well callused before planting. For long-term storage (6 weeks or more), keep well ventilated at 50°F (10°C) and with a relative humidity of 80%.

SCHEDULING: Number of days between planting date and bloom decreases as the planting date is moved later through the shipping season (SW42 - 39). Warmer temperatures and longer days accelerate growth & development. When potting callas October-December, the earliest and darkest plantings in the northern hemisphere, plan on 2-3 weeks more bench time to reach peak bloom. For such sub-optimal conditions, plan on using additional Bonzi, maintaining cooler finishing temperatures and optimizing available light.

ALWAYS PURCHASE PRECONDITIONED TUBERS

Though no exact scheduling has been perfected, some approximate averaged forcing times follow:

APPROXIMATE TIME TO FLOWER EXPRESSED IN WEEKS*				
(arranged in order of early to late flowering)				
CALLAFORNIA CALLA [®] CULTIVARS	JAN-FEB		MAR-MAY	
	FIRST FLOWER	PEAK (GA INDUCED) FLOWERING	FIRST FLOWER	PEAK (GA INDUCED) FLOWERING
LIPSTICK	8	9-10	7	8-9
DARK EYES	"	"	"	"
NEON AMOUR	"	"	"	"
LAVENDER GEM (Lavender Sensation)	"	"	"	"
AMETHYST (Purple Gem)	"	"	"	"
RUBYLITE PINK ICE	"	"	"	"
HOT FLASHES	9	10-11	8	9-10
MOON SHADOW	"	"	"	"
SUPER IVORY	"	"	"	"
ROSE GEM (Gem Rose)	"	"	"	"
RUBYLITE ROSE	"	"	"	"
SUPER GEM (Supergem)	"	"	"	"
REGAL (Noble)	"	"	"	"
ALPINE	"	"	"	"
GARNET GLOW	"	"	"	"
MINT JULIP (Crème de Mint)	"	"	"	"
CRYSTAL BLUSH	"	"	"	"
INTIMATE IVORY	"	"	"	"
CRYSTAL CLEAR	"	"	"	"
GOLD RUSH	"	"	"	"
ACAPULCO GOLD	"	"	"	"
NIGHT CAP	"	"	"	"
GOLD CROWN	"	"	"	"
RUBY SENSATION	"	"	"	"
LEMON DROP	"	"	"	"
STRAWBERRY PARFAIT	"	"	"	"
FIRE DANCER	"	"	"	"
TWILIGHT	"	"	"	"
SUPER MAC	"	"	"	"
PARFAIT	10	11-12	9	10-11
FLAME	"	"	"	"
YELLOW HYBRID (Golden Star)	"	"	"	"
SUNSHINE (Sunny)	"	"	"	"
FIRE GLOW (Fireside)	"	"	"	"
BLAZE	"	"	"	"
PILLOW TALK	"	"	"	"
PINK GIANT	"	"	"	"
SWEET TALK	"	"	"	"
SOLAR FLARE	11	12-13	10	11-12
PEACH CHIFFON	"	"	"	"
GOLDEN CHALICE	"	"	"	"

*Reduce average first bloom date by 5 days when using 2 1/2-3" (20/24 cm) tubers.

PLANTING: PLANT WITH 1" TO 1½" (2.5 – 3.8 cm) OF MEDIA OVER THE TUBER, ROUNDED SIDE DOWN, SPROUTS (EYES) UP. Pot sizes below 4 ½" (11 cm) standard are more difficult to grow due to root volume restriction, reduced buffering to wet/dry fluctuations and increased frequency of irrigation cycles (especially in clay pots). Additional care and management of fertility and irrigation are required in small or shallow pots because plants tend to be weaker, more easily stressed and, therefore, more disease prone. Noting that spring callas root from the top of the tuber, care should be taken to plant at proper depth. If tubers are too shallow the source of the roots can easily be subject to dry/salt stress. Furthermore, if the tuber is so shallow that it remains exposed, rooting will not effectively occur and it will fail to produce roots. This will result in plants that are "one sided" with no rooting, sprouting or growth, which can effect a considerable portion of the plant.

RECOMMENDED PLANTING TUBER SIZES/MULTIPLES FOR PRODUCING HIGH QUALITY CALLAFORNIA CALLA® POTS		
POT SIZE	TUBERS PER POT BY SIZE	EQUAL PERFORMANCE SUBSTITUTION/ALTERNATIVE
4 ½"	1 @ 1 ¾"* OR 2 @ 1 ½"* OR 1 @ 1 ½"	2 @ 1 ¼" OR 3 @ 1" 1 @ 1 ¾" = 2 @ 1 ¼" OR 3 @ 1" 2 @ 1"
5" (or "Scotch" pot)	2 @ 1 ½" OR 1 @ 2"	1 @ 2" 2 @ 1 ½"
6"	2 @ 1 ¾"* OR 1 @ 2 ½"* OR 1 @ 2 ¼" OR 1 @ 2"	1 @ 1 ¼" 1 @ 2 ½" 2 @ 1 ¾" 3 @ 1 ¼" OR 1 @ 1 ½" + 1 @ 1 ¼"
7"	3 @ 1 ½"* OR 1 @ 2 ½"	2 @ 1 ½" 1 @ 3"
8"	3 @ 1 ¾"* OR 3 @ 1 ½"	2 @ 1 ¼" 2 @ 2" 1 @ 3"
Quarts	1 @ 1 ¾"* OR 2 @ 1 ½"* OR 1 @ 1 ½"	2 @ 1 ¼" OR 3 @ 1" 1 @ 1 ¾" OR 3 @ 1" 2 @ 1"
Gallon Cans	1 @ 2"* OR 1 @ 1 ¾"	2 @ 1 ½" 2 @ 1 ¼"
*Best combination for top-quality pot. Grades: 2½" = 2½-3"; 2¼" = 2¼-2½"; 2" = 2-2¼"; 1¾" = 1¾-2"; 1½" = 1½-1¾"; 1¼" = 1¼-1½" " " 20/24cm; " " 18/20cm; " " 16/18cm; " " 14/16cm; " " 12/14cm; " " 10/12cm		

MEDIA: The medium should be well drained, a pH of 6-6.5 and have good air porosity (optimal porosity at 20% ±5%). Peat based media should use a coarse grade and be in the range of 30-50% of the mix. Lighter formulations, using less peat, are suitable for cooler, early winter plantings. Higher proportions of peat are sometimes used by experienced growers, but at the risk of enhancing disease pressure. Additional well-drained components include, but are not limited to, *graded* large particle perlite, sand, firbark, pumice or scoria. Redwood sawdust should not make up more than 30% of a mix. Pine bark is known to tie up Bonzi variably and should be used with care or avoided. *Graded* No. 2 sand can help ballast pots on taller varieties. **Incorporation of gypsum/lime** will help not only pH balance, but provide calcium for good plant health. A light two-week starter charge of a balanced fertilizer will help plants get off to a fast start. When mixing media, care must be taken to not over-grind components; the resulting reduction of particle size in such media will reduce aeration to the point of favoring root pathogens.

We recommend incorporation of *Trichoderma* biologicals such as **Root Shield** at a rate of 1 lb/yd³ (593gm/m³) or **Soil Guard** at a rate of 12 oz/yd³ (445gm/m³) into the media 3-7 days before planting to promote optimal root health, especially where fungicide labels are restricted.

Important note for winter forcing: Most calla forcing programs use liquid feed fertility. In low transpiration environments, such as winter forcing, a heavier or "greater water holding capacity" media will easily remain too wet & disease promoting. It must be recognized that in order to accommodate the frequent drench needs of fertilization/fungicide drenches/Bonzi applications, media must be suited to the conditions of the season. Adjusting the porosity or water holding capacity during "winter" to allow for weekly irrigations, for your seasonal climate, will help accommodate your drenches.

Sample media: 3 parts Coarse Peat : 2 parts Large Perlite :
2 parts 1/4-1/2" Firbark : 1 part #2 Graded Sand (optional for ballast)

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 fungicide drench program.

PLANT HEALTH & GROWTH: The *bacterial soft-rot syndrome*, which concludes with *Erwinia carotovora*, is generally preceded by water molds and Rhizoctonia. Other wounds or moisture/salt stresses also add to this profit-impacting pathogen complex. It is very important to follow media recommendations, avoiding water/salt stress. Use good sanitation, proper irrigation/leaching practices, 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 and good air porosity media, optimal fertility and salts management, as well as our preventative, four-component fungicide drench program, addressing Pythium, Erwinia and Rhizoctonia. See Drench section.**

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ENVIRONMENTAL & TEMPERATURE EFFECTS ON PLANT PERFORMANCE:

Optimal environment involves good air circulation, moderately high relative humidities and the highest possible light (only in hot and bright summer forcing conditions will 30-50% shade be necessary). High light yields more compact plants, more flowers and reduces the need for Bonzi. Consistent temperature regimes for each stage and avoidance of temperature extremes greatly enhance plant performance and health.

Recommended temperatures are stage dependent:

Stage #1 Root/Sprout Development – about 12-25 days from planting to 1-3" (2.5-7.5 cm) sprouts [depending on variety]; 75°F (24°C) days and 65°F (18°C) or a constant 68°F (19°C). Early, even heat improves vigor and determination. Bonzi is to be applied when sprouts reach a 0.5-2" (1.25-5 cm) sprout length [above soil].

Stage #2 Foliage Growth and Control – begins approximately one week after sprouting and starting at initial Bonzi application and continues to leaf unfurling, approximately from day 14-28 to day 50 [depending on variety]. Maintain 70°-75°F (21°-24°C) days and 55-60°F (12-15°C) nights. Note that nights can be cooled an additional 2-5°F (1-2°C) especially if light is poor or extending bench time is desired. (Cooling nights will reduce paclobutrazol use, plant height and will delay plant spacing requirement, but will add some bench time.) **However, A COLD PULSE PREDAWN is recommended at this stage as it significantly synergizes with Bonzi to control plant height.** A cold pulse can be initiated at 2-5 days after first Bonzi application.

Stage #3 Bloom Push and Control – is marked by flower buds beginning to push and color. This is approximately between days 50 and 75 depending on season, conditions and variety. Maintain 65°F (18°C) days and 50°-55°F (10°-13°C) nights. Even cooler temperatures can be used [2°-5°F (1°-2°C) lower than those above] during stages 2 and 3 and may be advised under poor light or no Bonzi culture. Such cooler temperatures will improve plant habit and reduce (or even eliminate) Bonzi requirements but will lengthen bench time, as well as increase water retention in the media. Note that temperatures of 50°F (10°C) and below start to arrest calla growth, which may be useful in "holding" a crop for a scheduled ship date.

NEGATIVE DIF/MORNING COLD PULSE: Providing a cold pulse during the early morning hours, 2-5 days after initial Bonzi can greatly improve compactness of plant habit and body, which can reduce paclobutrazol use/expense by improving its efficiency. When one does not appreciably lower average overall greenhouse forcing temperatures by providing active cooling with aggressive fans using a 5 to 8 am (predawn-sunrise) temperature drop, this technique does not greatly lengthen forcing times. Generally, the "cold pulse" is achieved by providing a "DIP" of 10°F (6°C) below target night temperatures, e.g., 58°F to 48°F dip. Multiple plantings require separate greenhouse zoning to accommodate staging of temperatures

Crop Timing - the only way to speed bloom in callas is to increase average temperatures. However, warm temperatures, especially under low light, will produce taller and softer plants. Early pale foliage with chlorotic leaf "checking" usually indicates excessive heat. So, for timing your crop, it is better to plant early and slow it down with cooler temperatures than to plant late and have to add heat in Stages 2 and 3.

HUMIDITY AND AIR FLOW: Constant overly humid and excessively hot or cold conditions can favor foliar diseases and/or root diseases, especially with no horizontal air flow and in low light and/or crowded plant conditions. Horizontal air flow, usually provided by fans hung in series around the greenhouse, is important in creating a non-

stagnant and uniform plant environment throughout. NOTE: Overly dry conditions reduce leaf widths, lessen general fullness and vigor which can even impact the number of sprouts that ultimately develop.

6

WATER MANAGEMENT is critical and dependent on seasonal temperatures, as well as water holding capacity of media. Keep pots moist but avoid excessively wet and excessively dry conditions. After initial wetting at planting, the first thorough watering (within 4 days of planting "preconditioned" tubers) should be a four-part preventative chemical drench (see Fungicide Drenches and Pesticides section No. 9). Then, water sparingly until leaves unfurl. In day 14-21 do a second chemical drench. Avoiding pooling and splashing since this can easily spread disease. **Alternate extreme dry then extreme wet soil conditions will cause root injury and will greatly increase pathogen susceptibility**, especially if slow-release fertilizers are used in warm conditions.

Note that dry stress can result in blindness and flower abortion and disease incidence. Irrigations should be full and thorough. Subirrigation methods of ebb & flood and capillary mat should be avoided, as they can spread disease and are difficult to leach.

The addition of Zero Tol at 1:1000 to 1:3000 for algae control is compatible with, and recommended for forcing callas as it assists in disease management. (See section No. 9–Fungicide Drenches and Pesticides). **Good quality water at an E.C. below 1.5 sustains plant quality, growth and overall plant health. High salinity or other water problems should be treated.**

7

FERTILIZATION: The ideal starter fertilizer precharge would be a 10-20 day soil incorporated application of N-P-K at approximately 15-3-15 (plus minors, if possible). Keep pots moist and E.C. levels initially between 1.5-2.0. Avoid E.C. levels above 2.5. It is best to avoid ammonia forms of nitrogen. We recommend growers use a constant 100-150 ppm balanced liquid feed which includes minors until leaf unfurling. During stage I germination and early stage II, *increasing the concentration in low light or/low transpiration and/low poor growth conditions is advised* (i.e., 100 ppm when weekly applications are possible; 200 ppm if bi-weekly; 300 ppm if infrequent); thereafter, reduce feed accordingly as plants begin to foliate and dry down faster. Uniform incorporation of slow-release or other granular fertilizers can be difficult, but can be done in individual pots by using approximately a 1.5 gram (1 tsp) of 15-3-15 well mixed into a 6-inch pot. Slow-release charges over 30 days tend to induce leaf margin salt burn if temperatures rise to above 78°F (25°C) and if pots dry excessively. Supplementing the media with 3 lbs. each of lime and dolomite per cubic yard (1.78 kilos/ cu. mtr.) can provide calcium for plant quality and disease tolerance. **Keep climate, growth and fertility records for future reference.** After canopy development clear water leaches @ 2:1 fert: water is recommended.

Iron Chelate: Pale foliage color can be corrected by the addition of an iron chelate at 6 oz/100 gal. (46.9 mls/100 L) of a 13.2% sequestered iron introduced with your liquid feed and applied weekly as the leaves unfurl. The use of Bonzi and cooler temperatures will also aid to darken foliage.

MODIFIED FERTILITY CONSIDERATION FOR LARGE-LEAVED GENETICS: In order to allow for greater light penetration into the canopy for flower induction & development, as well as improved plant habit, large-leaved varieties [like those found in the yellow/orange genetic grouping] will benefit from a modified fertilizer regime reducing Nitrogen (N) concentrations and increasing Phosphorous (P). An example of these ratios would be something similar to 50ppm N (vs. 100ppm N derived STD 20-10-20), 150ppm P (vs. 50ppm as STD 20-10-20) and where Potassium (K) remains constant. Preformulations of this type of blend can be readily obtained from products such as Peter's 10-30-20 "Hi Bloom". The greatest benefits will be recognized when modified feed is implemented at the time of Bonzi/PGR somewhere between "early" and "late sprouting". Once implemented, modified feed should be carried through the end of the forcing cycle. Plants produced with the above fertility outline will tend to be more compact and having smaller overall leaves, as well as modest-to-significant increases in traditional flower counts amongst these genetic groups.

Leach pot salts with clear water every third - fifth irrigation starting after leaf unfurling. It is best to leach 2:1 during the last 6 weeks, and particularly when producing small pots.

8

PLANT GROWTH REGULATION: **Bonzi (paclobutrazol @ 0.4% ai) is the most effective growth regulator and plant "toner" or "toughener" for spring callas.** The individual grower's product objectives and environments must be considered in Bonzi use. Factors other than concentration (ppm) greatly influence Bonzi efficacy. As Bonzi use is an art, as well as a science, take notes on your environmental conditions (media moisture at time of application, temperature, and light conditions post application, etc.) in order to achieve repeatable results next time. Apply Bonzi when all sprouts have emerged and are between 0.5" to 2" (1.25-5 cm) tall. Pots must be uniformly moist. So, it is best applied a day or two after an irrigation or the second fungicide drench. Segregate pots by sprout size treating tallest pots first. Then, when slower pots reach 0.5" to 2" (1.25-5 cm) sprouts, drench these pots also.

BONZI
now has
EPA
label
for
Callas

Second and subsequent applications are usually made 6-10 days after the previous one. Do not treat after 40 days post emergence. **Too much Bonzi will reduce flower counts and add bench time.** However, when properly used, Bonzi will greatly improve postharvest shipping quality & display. Slightly higher rates are favored when shipping over longer distances. A cool pulse PREDAWN DIP greatly improves Bonzi effect.

Our recommendation is to prepare a tank-mixed, final solution at your desired Bonzi rate and to apply it using a dosing/metering system, like a Dramm Chemdose™ or a Chemical Container Eze-Dose™, etc. This method will allow you to deliver precisely the desired rate of Bonzi from a diluted, ready-to-apply volume of solution (i.e., 10 ppm = 0.33 oz/gallon OR 33 oz Bonzi/100 gallons water (257.8 ml/100 L). **Use caution if and when "injecting" Bonzi. Better yet, AVOID USING INJECTORS to apply Bonzi.** Paclbutrazol is a very effective and persistent PGR. Therefore, a small deviation from your desired rate and the volume applied may lead to substantially varying results. Since injectors are prone to deviate and or drift from the setting shown (i.e., 1:200), regular maintenance and calibration of injectors is essential to successfully "inject" your Bonzi. Additionally, keep in mind that the Bonzi concentrate will be pulled from the concentrate tank in the form of a "pulse" or "dose." Without the use of a blending tank, your crop will receive varied rates of material. Ultimately, injectors will serve growers best in the roles of delivering fertilizer and/or fungicides, where deviations from rates are generally more tolerable.

*** In the absence of the above-mentioned specialized "dosing" equipment, we suggest the following spray tank method: Remove nozzle tip from wand and reduce pressure at regulator. Test fill a measuring cup to determine "trigger pull" rhythm for approximate dosing (4 oz solution/4" pot; 6 oz solution/6" pot (118 mls./11cm; 177 mls/15 cm).** *

See our Tech Sheets CD and/or Tech Sheet Flyers (available from your broker or download from www.goldenstatebulb.com / www.callaforniacallas.com) for specific recommendations regarding how much Bonzi to use by variety. Our conditions suggest we use 8-10 ppm [$\frac{1}{4}$ - $\frac{1}{2}$ oz/gal (2.0-2.5 ml/L)] on "x-low" and "low" use varieties and 10-15 ppm [$\frac{1}{2}$ - $\frac{1}{2}$ oz/gal (2.5-4.0 ml/L)] on "medium" and "high-use" varieties. Your experience and conditions may lead you to use different rates. In general, we recommend repeat applications at low concentrations (8-15 ppm) rather than single (or fewer) applications of higher concentrations. Solution volume per pot is as critical as ppm because Bonzi is trapped in the media and becomes concentrated if liquid is applied past runoff. A metering system is therefore advised. The above rates are based on moderate California light levels. We suggest drenching 6 ounces per 6-inch pot (177 ml/15 cm pot) and 4 oz. per 4 $\frac{1}{2}$ " pot (118 ml/11 cm pot). [Note: Certain media components such as pine bark can tie up Bonzi and reduce its effectiveness.]

The plants must be actively growing for Bonzi to be taken up by the roots and assimilated. Cold dark conditions immediately post application will, therefore, greatly reduce Bonzi effectiveness. Keep your environment stable and within the recommended temperatures for consistent and replicable results. **Keep good records.** Slightly cooler temperatures in Stages 2 and 3 and high quality greenhouse coverings or supplemental lighting will also improve plant habit and tone. **Factors impacting plant habit/quality (causing weakness and stretching) include low light or short light hours, long periods of far red light (twilight), excessive nitrogen, high temperatures, plant crowding and poor ventilation; therefore, these factors should be managed accordingly to achieve best results.**

9

FUNGICIDE DRENCHES AND PESTICIDES:

DISEASE CONTROL AND PLANT HEALTH: Constantly 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. Having conducted extensive research on efficacy of fungicidal/bactericidal drenches, GSBG has concluded the best results for their use, combinations and alternatives (see written details below and chart that follows).

Our best FOUR-PART TANK MIX chemical drench combination against the "pathogen complex" for a successful program: 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.

Remember that managing Pythium and other water molds is most critical. See our "Three Pathogen Calla Fungicide Drench Chart" below for these primary recommendations and other, lesser alternatives, should these not be available. Although callas tend to be tolerant to chemical phytotoxicity, trial other fungicides first on a small basis if our recommended chemicals are not labeled in your locale.

The Erwinia 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.

DRENCH TIMING: Drench timing is critical. Drench the first time, when using preconditioned tubers, anywhere within 2 to 6 days of initial watering. If not using preconditioned tubers, drench within the first 2 to 3 days of initial watering. Timing of the second drench is important and should be made at 14 to 21 days after first drench and usually around the time of Bonzi application (provided Bonzi is applied within this 21-day period). 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, uneven growth, any diseased plants, or if poor or prolonged shipping environments may be expected. **ALWAYS DRENCH IN THE MORNINGS OR EARLY ENOUGH FOR ALL FOLIAGE AND RUNOFF TO DRY THOROUGHLY.**

Three Pathogen [FOUR-PART] Calla Fungicide Drench Chart	
All rates below are designated per 100 gal () indicates they are per 100 liters	
(1) ERWINIA	<u>RATES</u>
⊕ 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)
(2) WATER MOLDS	
⊕ 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)
Segway/Ranman (cyazofamid 53.45% ai) <i>liquid</i> **	2-6 oz/100 gal. (16-48 ml/100 L)
(3) RHIZOCTONIA	
⊕ 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)
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)
⊕ Primary four-part tank mix	
** 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.	
** Segway/Ranman is a new and very effective chemical (trial in your conditions for best results)	
** <u>Aliette combined with Phyton-27 can occasionally be phytotoxic for foliage.</u> Be careful not to get this combined mix on the foliage.	

PRODUCT REGISTRATIONS, LABELING AND AVAILABILITY VARY BY LOCALE. Due to the nature of our product being consumed internationally, please consult your local information or farm/grower extension agency for usages or alternatives. **IF ANY OF THESE PRODUCTS ARE NOT AVAILABLE IN YOUR LOCALE, THEN ADDRESS THE THREE MAJOR PATHOGENS COMPREHENSIVELY WITH THE BEST PRODUCTS AVAILABLE.** Seek appropriate consultation for your area/region. Callas tend to be tolerant of most products, and we encourage experimentation (and record keeping) with new products 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. Silicates are also correlated with stronger stems and tougher leaves more resistant to foliar pathogens.

BIOLOGICAL AND ALTERNATIVE (GREEN) APPROACHES:

As a supplement to chemical controls or where no chemicals can be used, a media incorporation of the biological control Trichoderma is useful as Root Shield @ 1 lb/yd³ (593gm/m³) or Soil Guard (Gliocladium is related to Trichoderma) @ 12 oz/yd³ (445gm/m³). 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**. The use of Zero Tol (hydrogen dioxide 27% ai) at 1:1000 to 1:3000 for algae growth in constant feed has routinely proven to help manage pathogens as well.

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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 recommended chemical drench combination with optional Trichoderma at 21-28 days and, if necessary, near day 42 as well.

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) for bacterial problems. For fungal leaf spots, use Daconil Weather Stik (a.i. chlorothalonil @ 54%) at the rate of 22 volumetric ounces per 100 gallons (1.72 ml/L) or use Chipco 26019 26GT (a.i. Iprodione @ 23.3%) at the rate of 32 volumetric ounces per 100 gallons (2.5 ml/L). If both bacterial and fungal leaf spots are present, do a tank mix of above and **watch residues at the higher rates**. 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 pots and excessive fertilizer release with temperature-dependent slow-release fertilizers, or a lack of the recommended clear-water leachings.

DO NOT COMBINE FOLIAR COPPERS WITH ALIETTE OR OTHER ACIDIFYING PRODUCTS OR WHERE WATER SOURCES THAT HAVE A PH THAT TENDS/MOVES BELOW 7.0 (NEUTRAL). Test your solution for pH before spraying anything that may be in question. Always spray or drench in the morning or early enough to allow the materials to thoroughly dry, otherwise extensive activity while still in solution may lead to inadvertent phytotoxic damage.

Leaf tip clearing at emergence, which we refer to as “vidrio” can lead to foliar disease in dark, humid conditions and must be treated as above immediately to prevent worsening and possible collapse to secondary diseases. Also improve ventilation.

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GREENHOUSE SANITATION: *Always remove diseased plants from the greenhouse. Sanitation is critical, especially in multiple cropping programs where rot can progress without an obvious cause. Therefore, between crops sanitize benches, floors, conveyors, pots, soil mixers, etc. See also control of Fungus Gnats and Shoreflies below.*

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INSECTS: Control of Fungus Gnats and Shoreflies is important due to their ability to spread bacteria and disease. Generally, callas are relatively tolerant to phytotoxicity of foliar sprays, and label rates of most insecticides can be used safely. Control on an as-needed basis for white flies, aphids and thrips are recommended. Early leaf-chewing evidence by larvae after sprouting requires an insecticide drench as soon as possible.

Control thrips as they can sometimes rapidly spread the foliar viruses INSV (Impatiens Necrotic Spot) and TSWV (Tomato Spotted Wilt). Control aphids as they can spread DMV (Dasheen Mosaic Virus).

ALWAYS WATCH FOR ERWINIA INFECTED PLANTS AND CAREFULLY REMOVE AND DISCARD.

THESE INSTRUCTIONS ARE NOT A PRESCRIPTION OR GUARANTEE, NOR RECOMMENDATIONS OR ENDORSEMENTS OF CHEMICALS MENTIONED.

MUST DO STEPS	PAGE NO.
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- 1) Order only Preconditioned Callifornia Calla[®] Tubers.
If purchasing non-GA'd/"Not Preconditioned" tubers,
follow new recommendations for disinfectant and GA
spraying. 1

- 2) Sort and air dry bulbs before planting. 1

- 3) Plant with only 1 to 1½" (2.5-3.8 cm) of media covering tuber. 3

- 4) Use well-drained media with good porosity.
(Incorporation of Trichoderma biologicals is beneficial.) 3-4

- 5) Follow optimal temperature regimes by stages. 4-5

- 6) Follow proper water management recommendations. 5

- 7) Follow fertility recommendations and avoid ammonium
forms of nitrogen. Clear water leach every third to fifth
irrigation. 5

- 8) Plant growth control and Bonzi require special
considerations and record keeping. 5-6

- 9) Drench within 2 - 6 days of planting "preconditioned"
tubers using the chemical combinations mentioned. 6-8

- 10) Re-drench with our recommended strong preventative
program day 14 to 21 (pre Bonzi) and again day 40-47. 7-8

- 11) Maintain greenhouse sanitation. 8

- 12) Control fungus gnats, shoreflies and chewing larvae as
well as thrips and aphids for virus vector control.
Watch and control for leaf and flower spot. 8



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