

## **The 2013 Easter lily schedule: Managing temperature response in a changing climate.**

Richard McAvoy, Professor and Extension Specialist – Greenhouse Crops  
Department of Plant Science and Landscape Architecture  
University of Connecticut

The secret to scheduling the Easter lily crop is proper temperature management at each stage of development. Unusual weather patterns, along with the shifting Easter date, are always part of the challenge to growing this crop. The extreme climatic conditions that much of the nation experienced during the 2012 lily season may signal a new normal for growers to contend with. With record high temperatures for much of winter 2012 many growers saw crop development ahead of schedule and low to average bud counts. January 2012 was the 4<sup>th</sup> warmest on record and March was even more extreme with record high temperatures over the eastern two-thirds of the nation from the high plains to the east coast, extending north into Canada and south to Florida. In International Falls, Minn., temperatures spiked from a low of minus 14 degrees on March 9, to a high of 79 degrees on March 18. Chicago, Ill. recorded eight consecutive days above 80 degrees in March, a pattern normal for mid-June, and Boston experienced the first above 80 degree day before March 28 in 91 years. For tens of millions of Americans, it was the warmest March in their lifetimes as over 15,000 warm temperature records were broken. The heat confused plants and insects as well, leading to an unusually early blooming of the cherry trees in Washington and apple and peach trees in the Midwest. The only part of the nation that experienced a cooler-than-average March was the West Coast. If we experience similar extremes this season, growers will need to pay close attention to crop development and have the ability to adjust temperatures as needed.

In 2013 Easter Sunday falls on March 31. This is considered an early date Easter but the schedule allows adequate time for the full 23 week program. To stay on this schedule, growers will need to begin the process by October 21, 2012 and maintain proper cooling and forcing temperatures throughout. This requires that bulbs arrive on time and in good shape and that you are prepared to handle them immediately. The key steps in the forcing program for pot-cooled bulbs include a three-week rooting period (at 63°F) followed by six weeks of bulb cooling (at 40-45°F). Then plants are forced in the greenhouse at 60-62°F until bud initiation is complete (about 4 weeks). Once buds are set, higher temperatures are used to force the crop during the final 10 weeks. With case cooled bulbs the process involves six-weeks of bulb cooling at 40-45°F followed by a 17 week greenhouse phase during which bud initiation occurs and the crop is forced to flower. In both cases the entire process requires 23 weeks from start to finish. If bulbs arrive late or if your sales schedule calls for lilies earlier than 1 week before Easter, there are a couple of ways to save time. With pot cooled bulb you can reduce the length of time that pots are held at 63°F prior to the six-week cooling period. If you are tempted to cheat here, allow enough time for bulbs to show some root development, two weeks if at all possible but at least one. As an alternative or if your schedule is still a little tight, you can substitute “insurance lighting” for a portion of the 1000-hour (6-week) bulb-cooling period. The same insurance lighting rule applies to all forcing methods including naturally cooled, pot cooled or controlled-temperature forced (CTF), and case cooled bulbs.

Insurance lighting is achieved by providing at least 10 foot-candles (measured at plant height) for four hours (10 pm to 2 am) each night. Lilies exposed to these long photoperiods immediately after shoots emerge, respond as if the bulbs were exposed to additional hours of cool (40°F) temperatures. In seasons when Easter falls on an early date, growers can extend the natural daylength with low intensity light to “insure” that adequate vernalization occurs. Just like exposing bulbs to 1000 hours of vernalizing temperatures, “insurance lighting” reduces leaf (and flower) number and reduces the number of days from emergence to flowering. “Insurance lighting” can be used to directly substitute for lost bulb cooling time. That is, one week of “insurance lighting” will substitute for one week of cold temperature vernalization. Lighting is most effective when started immediately at emergence and for a period of up to two weeks following shoot emergence. However, DO NOT use insurance lighting unless the crop is short of the 1000 hour bulb cooling threshold and then only provide as many days of “insurance lighting” as needed to reach the 1000 hours target. Just like excessive cooling, excessive lighting will reduce lily leaf number, reduce bud counts and shorten the time to flower. Incandescent, florescent, or HID lamps can be used to provide the necessary night break.

Even though Easter 2013 is early, avoid the temptation to speed up lily growth in the first few weeks after emergence. Too often, growers run temperatures in the 70 to 75°F range during this critical period in a misguided effort to get ahead of schedule. The result is excessive lily height, poor bud counts and prolonged cold storage periods at the end of the crop. At emergence, hold a constant day and night temperature of 60-63°F until bud initiation is complete. Bud initiation is typically set when shoots are about 3"-5" tall, mid- to late-January 2013. The development of stem roots coincides with flower bud initiation. During this period, it is imperative that temperatures not exceed 65°F. If you find yourself short on time, increase the rate of lily development after bud initiation is complete. Do not attempt to make up lost time with high temperatures during the bud initiation period.

With a tight schedule growers should pay careful attention to variations in performance of bulbs from different sources as bulb lots often differ in both leaf count and finishing time. These differences can be detected early in the forcing process but growers who fail to respond end up off schedule. You can gauge differences in the maturity and finish time of various bulb lots by counting leaves as soon as bud set is complete.

### ***Leaf counting & crop timing:***

Start checking leaf counts in mid-January (week 11). If bulb set is not yet complete, wait one week and try again. This will allow you plenty of time to determine if lily development is on schedule and to make the necessary temperature adjustments as needed. Use average daily temperature to control the rate of lily development for the remainder of the forcing period. The rates of both leaf and flower development can be modulated with temperature. By controlling the rate of development you can control when the crop reaches the saleable stage. For example, at an average daily temperature (ADT) of 72°F leaves unfold at a rate of 2 per day on average, while at 63°F the rate decreases to 1.5 leaves per day. Likewise, a lily will go from visible bud to bloom in 24 days at 81°F, 31 days at 70°F, 35 days at 64°F and 42 days at 59°F. If you arrive at visible bud 5 to 7 weeks before Easter and you can control temperature within these limits you should be in good shape to finish on time. Finally, plants that bloom early can be held in a cooler for up to

two weeks. Storing finished lilies for longer than two weeks is not recommended. Many growers were forced to store lilies for long periods in 2012 due to the unusually warm March.

The leaf counting technique is based on the fact that once flower buds initiate, leaf number is set and will not change. However, the exact number of leaves varies from year to year, between bulb lots, and with bulbs exposed to different cooling conditions.

After bud initiation, select five lilies for every 1000 plants in each lily group (per bulb source, emergence time etc). Select plants representative of the overall crop, and then remove, count and record the total number of leaves. Use magnification and a needle to remove and count the smallest, un-expanded leaves. (Note: The shoot tip should show evidence of tiny flower bud formation. If bud formation is not evident wait a week and try again.) Record the number of fully developed leaves (those at a 45° angle to the stem or greater) and the number of undeveloped leaves (those at an angle less than 45° to the stem). Now, divide the number of fully developed leaves by the number of days since shoot emergence. This is the “current rate of leaf development”. Divide the number of undeveloped leaves by the number of days remaining until visible bud. This is the “required rate of leaf development” or the rate you need to maintain as you move forward in the schedule.

If the “current rate of development” is too fast, meaning you will reach visible bud too early, reduce the average daily temperature (ADT) in the greenhouse. If the “current rate of development” is too slow, meaning you will reach visible bud too late, increase the ADT.

Determine a new current rate each week (the rate since last count) and a new required rate. Determine the new required rate by subtraction - you do not have to destroy any more plants. Simply subtract the number of fully developed leaves from the average total number of leaves previously determined. You can flag your indicator plants and use a marking pen to mark the last leaf you counted as mature.

**Height control:** The 2013 schedule has lists lily height targets for each week in the greenhouse. You can adjust these targets to fit your needs (e.g. increase plant height if you desire a taller finished product). This schedule is designed to produce a finished plant of about 16”. You can chart the height of your crop against these target heights. Monitor lily height on a regular basis (daily, bi-weekly or weekly) and compare the actual height to the idealized growth curve for the lily height you wish to produce. If average plant height is too short, run a positive DIF to increase stretch. If plant height is too tall, run a negative DIF to slow elongation.

While using DIF to control height it is extremely important that you maintain the proper average daily temperature (ADT) so that crop timing is not adversely affected.

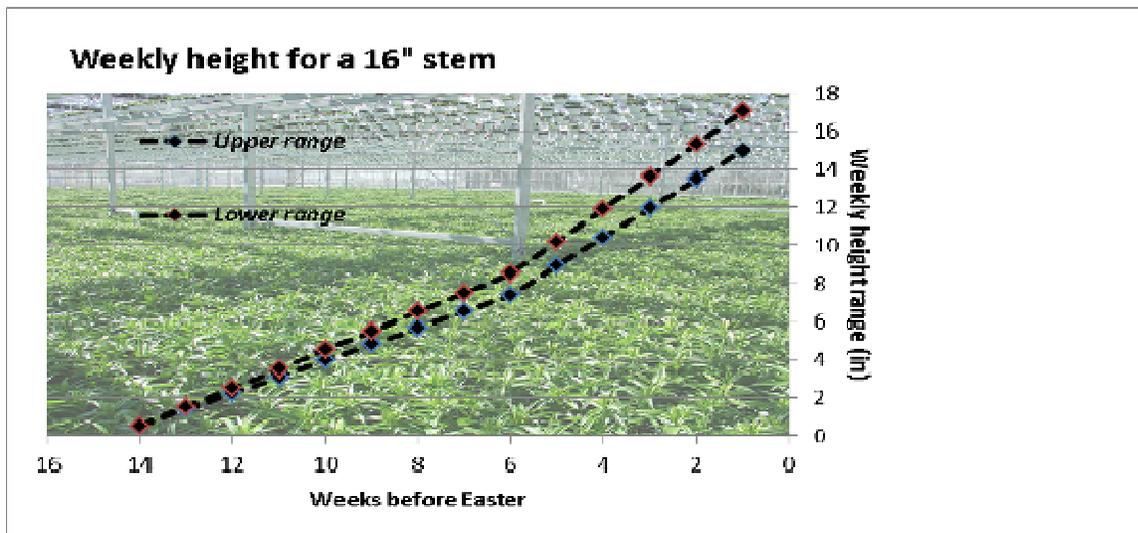
**Controlling Lily Height with PGRs:** Lilies typically double in size in the 5 week period from visible bud to bloom but it takes 9 weeks of forcing prior to visible bud to reach the first 50% of final lily height. A-Rest, Abide, Chlormequat E-Pro, Concise, Cycocel and Sumagic are all labeled for use on Easter Lilies. PGR applications typically begin when lilies reach 3-5" tall or after buds are set. However, with low concentration split applications, PGRs can be applied at

any point in development beginning with emergence. A-Rest and Sumagic (or the generic equivalents) can also be used to pre-treat bulbs using bulb soaks. With sprays and drenches, split applications produce the best results. Reduce the concentrations of PGR used when combined with negative or zero DIF.

**Leaf yellowing:** Crowding, root disease and poor nutrition (especially low phosphorus and nitrogen) during the final stages of development and stress from unfavorable cultural and environmental conditions such as excessive shading and high temperatures all favor lower leaf yellowing. Last year leaf yellowing was a problem for some growers most likely due to the unusual weather but also because lilies were too crowded and too tall too early. If you experience conditions that favor lower leaf yellowing during the final weeks of forcing, apply Fascination or Fresco. Applications in the weeks prior to visible bud or two weeks after visible bud should be applied only to the lower leaves to avoid stem stretching. Higher rates can be applied over the entire plants on mature lilies ready to go into cold storage.

We don't know what climatic changes will occur in 2013 but proper attention to detail and control of the production environment will go a long way toward mitigating extremes and allow you to bring a quality crop in on time.

Lily height is always a critical concern. The final height is dependent on how well you control stretch during the entire forcing period. Typically growers target a final height that falls within a narrow range. The Easter lily schedule in this article is designed to produce a lily with a final overall stem length of 16". With a pot height of 6" this would be a plant with a final overall display height of 22". Lilies typically double in size in the 5 week period from visible bud to bloom but it takes 9 weeks of forcing prior to visible bud to reach the first 50% of final lily height.



Unusually warm temperatures in March pushed lily maturity earlier than desired in 2012. The lilies pictured here still have 17 days to go before Easter. Cold storage for longer than 14 days is undesirable. Monitor development during the entire greenhouse forcing period and adjust temperature regularly to avoid long storage intervals.



Lily height can be controlled with plant growth regulators and temperature (DIF). The lilies (left) too tall to clear the watering boom still have 7-10 days to go before shipping. Lilies of the same age (right) are considerably shorter. Monitor lily height regularly. Low concentration PGRs can be applied throughout the production period to control stretching within the desired range.



Preplant bulb soaks with Sumagic were used to produce this extremely uniform run of Asiatic-hybrid lilies. Rates will vary with cultivar and some in-house testing will be needed to refine the technique.



Tight spacing and poor air movement at the end of the crop created problems in 2012 with lower leaf yellowing followed by botrytis on these Asiatic lilies.



## 2013 EASTER LILY SCHEDULE

Weeks Prior to Easter	Date	Forcing method	
		Case-Cooled	Pot-Cooled (CTF)
24	Oct. 14	<i>This schedule designed to produce 16" lilies that bloom 1-week before Easter. Bulbs dug in early October and shipped. Prep for lily arrival by testing your soil &amp; checking your environmental control &amp; crop production systems. Inspect bulbs for insects, rots or physical damage. Pot bulb &amp; starts programming immediately.</i>	
23	Oct. 21	<b>Start bulb programming as soon as bulbs arrive but no later than 23 weeks before Easter.</b>	
20	Nov. 11	Cool at 40-45F for 6 weeks	Pot and allow roots to grow at 60-62F for 3 weeks
17	Dec. 2	---	Cool at 40-45F for 6 weeks
14	Dec. 23	<b>Pot no later than 17 weeks before Easter</b>	
13	Dec. 30	Force in greenhouse at 60-62F in pot.	---
12	Jan. 6	<b>Shoots emerging ~ 0.5" tall &amp; buds beginning to set.</b> Start fertilizing & keep moist.	
11	Jan. 13	---	Begin greenhouse forcing no later than week 14. Maintain pots at 60-62F.
10	Jan. 20	1.25-1.5" tall. Keep lilies moist & use fungicide drench as needed. Run 60-62F day/ night during bud initiation. Bud initiation coincides with stem root development.	
9	Jan. 27	2.25-2.5" tall. Run 60-62F day/ night during bud initiation. Check for bud set & begin leaf counting and graphical tracking.	
8	Feb. 3	3-3.5" tall. Apply growth regulator as needed. Keep below 65F until bud set is complete.	
7	Feb. 10	4-4.5" tall. Begin leaf counting as soon as bud set is complete. Use temperature to control the rate of lily development & DIF to control height. ADT 65-70F. Check for aphids & root problems. Apply Marathon sometime during weeks 10, 9, or 8.	
6	Feb. 17	4.75-5.5" tall. Space lilies to avoid yellow leaves & stretching. Soil test & if leaf scorch is evident, use 15-0-15 for balance of schedule otherwise maintain complete nutrition. Repeat leaf count on late batches of lilies.	
5	Feb. 24	5.5-6.5" tall. Adjust temperatures as needed.	
4	Mar. 3	6.5-7.5" tall. 42 days to sale. Buds can be felt.	
3	Mar. 10	If buds are visible on early planting run 60F until finish.	
2	Mar. 17	7.25-8.5" tall. Buds ~0.75". Lilies are about half final height. Buds should be visible no later than 30 days prior to sale. Grade for uniformity as buds become visible. Apply Fascination or Fresco if leaf yellowing is evident, or if cooling is anticipated.	
1	Mar. 24	Lilies 9-10.25" tall. Buds 1.25" long.	
0	Mar. 31	Lilies 10.5-12" tall. Buds 1.75-2" some bending down.	
		Lilies 12-13.5" tall. Buds 2.75". If aphids present, use a total release smoke or aerosol.	
		Lilies 13.5-15.25" tall. Buds 4-4.25" long. some turning whitish. Stop fertilizing & apply clear water once before sale. Cool lilies at 35-45F to hold. Apply Fascination or Fresco prior to cold storage.	
		Final lily height 15-17" tall. Buds 6-6.25" long & at or near bloom. Shade lilies immediately after they are removed from storage.	
		<b>Easter Sunday 2013</b>	

## NOTES & COMMENTS ON THE 2012 EASTER LILY SCHEDULE

*Easter 2013 outlook: Easter falls on an early date in 2013 (March 31). The 2013 schedule is tight but allows adequate time to complete the full 23 week program. If you have problems contact your Extension Educator.*

*Pot-cooled bulbs are normally potted & held for three weeks at 60-62F before the six weeks of bulb cooling (at 40-45F) begins (see the 2013 Easter Lily schedule for details). The bulbs then require 14 weeks of greenhouse forcing. This entire process requires 23 weeks from initial potting to Easter. This same process is used for both naturally cooled or CTF bulbs.*

*Case-cooled bulbs require six weeks of cooling followed by 17 weeks of greenhouse forcing to flower in time for Easter. Be sure that commercially case-cooled bulb arrive & are planted by Dec 2, 2012. If you cool your own bulbs, start as soon as bulbs arrive but no later than Oct 21, 2012 (23 wks before Easter).*

**Insurance lighting:** Insurance lighting may be needed this year if you are unable to complete the full 6-weeks (1000-hours) of bulb cooling before the designated greenhouse forcing date. Substitute 1-day of insurance light for each day of bulb chilling required for the full 1000 hours. See article for details.

**Fertigation:** Start fertilizing using a 15-0-15 or comparable formulation when lilies emerge. If phosphorus was not added to the medium, 20-10-20 can be used on an alternating basis with a 15-0-15. Fertilizer rates should range from 200-400 ppm. Do not allow medium EC to exceed 3-3.5 mmho/cm based on a Saturated Media Extract. Stop fertilizing 1-week prior to sale. Provide one clear watering before shipping lilies - this will reduce salt levels in the potting medium and maximize keeping quality. Do not withhold water or fertilizer to slow development. Do not over water (i.e. water too frequently) or root rot problems may occur.

**Decrease Leaf Yellowing & Delay Flower Senescence:** To prevent early-season leaf yellowing (7 to 10 days before visible bud) & mid-season leaf yellowing (7 to 10 days after visible bud) spray Fascination or Fresco at 10/10 ppm. Apply only to lower leaves & cover thoroughly. To prevent late-season leaf yellowing and post-harvest flower senescence, spray 100/100 ppm to thoroughly cover all foliage & buds. Apply when buds are 3 to 3 ½" long BUT NOT MORE than 14 days before shipping or cooling. Protects leaves from yellowing for up to 14 days. Note: Avoid direct contact of spray to immature leaves during early- & mid-season applications or increased stem stretch will result.

**Disease and pest control:** Before planting, clean bulbs of debris removing any damaged scales, especially scales that show evidence of infection. Once potted, root rots associated with *Rhizoctonia*, *Fusarium*, and *Pythium* are a concern. Drench immediately with Banrot or Insignia, broad-spectrum fungicides, or you can treat to control these diseases separately by selecting from the fungicides specifically registered for *Rhizoctonia*, *Fusarium* and *Pythium* control on lily. Materials registered for *Rhizoctonia* and/or *Fusarium* include 26GT, 26/36, Contrast (*Rhizoctonia*), and Terraclor WP (*Rhizoctonia*). Materials registered for controlling *Pythium* include Alude, Banol, Subdue Maxx, and Truban. Check with manufacturers regarding compatibility when tank mixing fungicides. Fungicides may also need to be re-applied later in the crop, check labels for guidance. Preventative biological fungicides (RootShield, CEASE, Actinovate, Mycostop or Companion) may also be applied for disease suppression and to enhance root growth. Check with company or product labels information on time intervals between application of biological fungicides and traditional fungicides.

Aphids, fungus gnats and bulb mites are a major concern. Use only aerosols once in bud. Many chemicals are listed for aphid control, including, Safari, Flagship, Tristar, Marathon, DuraGuard, Distance, Enstar AQ, Preclude TR, Tame, UltraPure Oil, Insecticidal Soap, Talstar and Endeavor. Fungus gnats can be controlled with many of these same chemicals as well as Citation, Adept, insect parasitic nematodes (Nemasys, NemaShield, Scanmask) and Gnatrol. Bulb mites, *Rhizoglyphus robini*, represent one of the more troublesome insect pests on lilies and effective management requires an integrated approach. Bulb mites are considered a secondary pest and are commonly associated with decay caused by fungus gnat damage and soil-borne fungal pathogens. To best manage this problem, sort out diseased and damaged bulbs before planting, handle bulbs gently and monitor and control fungus gnats. Duraguard is labeled as a drench for soil borne organisms that may include bulb mites.

*Note: Registration of pesticides varies by state so consult and follow labels for registered uses. To avoid any potential phytotoxicity or residue problems, spot test first before widespread use. No discrimination is intended for any products not listed.*

**Controlling Lily Height:** Use A-Rest, Chlormequat E-Pro, Concise, Cycocel or Sumagic as needed when shoots are 3-5" tall. Split applications provide the best results. You can apply any of the PGRs at ¼ to ½ normal rate as needed, to control height. Reduce the concentrations of Sumagic used when combined with DIF. Use DIF, or cool morning DIP, to control lily height. Equal day/night temperatures, high night/low day temperatures or a cool morning temperature dip will keep lilies short. Monitor lily height regularly during forcing. If height exceeds the target size, run negative DIF to slow stem elongation. If height is less than the target size, run positive DIF to increase stem elongation.

**Lily storage:** Lilies can be stored for up to 14 days in the dark at 35-45F when buds turn white but before they open. Spray for Botrytis control prior to moving lilies to cold storage. Materials registered for botrytis control on lilies include 26GT, 26/36, Daconil, Exotherm Termil, Sextant, and Protect DF. Follow label directions. Water Easter lilies thoroughly before starting cold storage. After removing from the cooler, place lilies in a shady location to avoid excessive wilting.

### If you have problems contact your Extension Educators.

All agrichemical/pesticides listed are registered for suggested uses in accordance with federal and Connecticut state laws and regulations as of the date of printing. If the information does not agree with current labeling, follow the label instructions. The label is the law. Contact the Connecticut DEP for current regulations. Where trade names are used for identification, no product endorsement is implied nor is discrimination intended.

Gregory Weidemann, Director. Issued in furtherance of the Acts of Congress of May 8 and June 14, 1914. The University of Connecticut, Storrs, CT 06269. The Connecticut Cooperative Extension System programs and policies are consistent with pertinent federal and state laws and regulations on nondiscrimination regarding race, color, national origin, religion, sex, age or handicap.