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Easter Lily Guidelines….Easter, April 16, 2006

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Easter in 2006 is April 16, and is considered to be a late Easter date. On the basis of Easter date, it will be useful for you to review your crop records from 2001 (April 15) and 1998 (April 12). Next year's date is very close to 1998 (April 12) and even as far back as 1995 (April 16), if you still have them.

Late Easters are especially important for Fascination, as use of this product allows crops to be stored for 2 weeks after reaching the puffy bud. Fascination has been on the market since the 2001-2002 season and a very high percentage of lilies in North America are treated with it. Fascination is highly effective in combating lower leaf yellowing in the greenhouse and the rapid, postharvest leaf yellowing often seen in plants that are abused in the shipping chain.

Given that we have a late Easter date in 2006, it might be useful to review some responses of the Easter lily to the cold treatment that is required for proper flowering. The cold treatment given to Easter lilies is *vernalization*, that is, a moist-cold treatment applied to a plant (or plant part) that is in a vegetative condition at the time of treatment. This cold period causes numerous biochemical and molecular changes within the plant (floral induction) *that cause earlier flower later on, after the plant is returned to a warm growing environment* (i.e., the greenhouse). The plant (bulb) is still vegetative when placed in the greenhouse, and flowers are only formed (floral initiation) after a period of several weeks. Therefore, vernalization *induces or predisposes* a plant to flower earlier and more vigorously than it would otherwise. Easter lilies classically are given 1,000 hours (6 weeks) of cooling at 40-45°F for proper vernalization. Experimentally, lower temperatures (32-33°F) still allow cold accumulation, but at a slower rate than optimum at 40-45°.

With Easter lilies, however, there are several negative effects of vernalization. Perhaps the most important is that as the length of vernalization alters plant growth in two very important ways:

1) the number of flowers and leaves decreases
2) the forcing time (time of removal from the cooler to flowering) decreases

Thus, too much vernalization (too many weeks of cold) is undesirable in general, and in a late Easter year in particular. Overcooling can easily occur from the mistaken view that it's better to leave bulbs in the cooler for an extra week or 10 days past the recommended removal date because, after all, it's a late Easter and if plants are put into the greenhouse later, then they should flower later. This is wrong, because of the more rapid flowering speed resulting from the extra cooling. Thus, keep to the schedules and do not over-cool.

Fascination

Fascination is a 1:1 mixture of gibberellin 4+7 (GA4+7) and benzyladenine (BA), and is identical to Promalin, which was tested for many years before Fascination was introduced. Labeled by Valent for the prevention of greenhouse or postharvest leaf yellowing, Fascination has found widespread use on lilies, and most North American crops are now being treated with it. The product has a dramatic effect, giving significant improvements in postharvest quality as a result of less lower leaf yellowing, and, with some applications, significantly improved flower longevity. Both effects are almost completely due to the GA component of the product. Recipes for the preparation of Fascination sprays are given in the nearby table.

The problem with Fascination is that the gibberellin that does so much to retard leaf senescence and improve flower longevity also causes stem elongation. This is true when the GA is applied when stems are actively elongating. Since Easter lily stems elongate throughout their development until flowering, Fascination can lead to unplanned elongation whenever it is applied to Easter lilies.

What's new with Fascination?

As in life, the more we learn about Fascination, the more complex it becomes. We have long known that Fascination tends to stay in the leaves to which it is applied. That is, it does not move sideways to other lower leaves, nor does it move out of lower leaves and move upwards in the plant. This observation, made by Susan Han of U. Massachusetts, lead to recommendations to ensure "complete coverage of the lower leaves". Otherwise, one might end up with spotted leaves, or perhaps green leaves on one side of the plant, and yellow on the other.

Because of this, the academic community used to assert that Fascination does not move in the plant. *However*, *Fascination does move readily in lilies if it is absorbed by roots*, a phenomenon that could occur as a result of "full and complete spray coverage", which would allow Fascination to run into the soil. This has important implications for unwanted elongation.

To demonstrate this, a few years ago we sprayed plants (approximately at visible bud) with10, 25, or 50 ml of Fascination (at 25 ppm), and covered the soil so the excess Fascination could not run into the root zone. In the control plants (soil surface not protected), there was a progressive increase in plant height at flowering. If we covered the soil surface, so that no Fascination drained into the root zone, *no elongation occurred*.

From this, we conclude that elongation seen in the early days of Fascination was almost certainly due to *root uptake* of the gibberellin. Thus, not only must you avoid spraying the upper part of the plant, you must also avoid getting excess Fascination onto the soil.

Experimentally, root-applied Fascination is also effective at suppressing leaf yellowing. Drenching the soil with various volumes of Fascination lead to similar reduction of leaf yellowing as comparable spray treatments. The plants were also much taller, due to root uptake and upward gibberellin movement to the growing point. It can be concluded that Fascination is highly mobile in the water stream of the plant. While it does not move out of leaves, it readily moves upwards in the plant when absorbed by roots

Typical forcing schedules are provided below as a benchmark for the upcoming season.

Flower Bulb Research Program

Easter, April 16, 2006
2006 Pot cooling (Controlled Temperature Forcing)
With pot cooling, the basic idea is to plant the bulbs soon after arrival in mid-October, give up to 3 weeks rooting time at 63°F, then cool starting 22 weeks before Easter.

Bulbs will be received starting in mid-October. CTF plants typically flower in 110 days (ca. 16 weeks) when forced "easily". Since Christmas Day 2005 is exactly 16 weeks before Easter, you will probably move plants into the greenhouse a few days earlier than you might otherwise, therefore giving a little more forcing time this year. Depending on time of receipt of the bulbs, you should be able to give 2 to 3 weeks of warm (63F) rooting before beginning to cool pots for 6 weeks. Upon arrival, plant bulbs, water thoroughly, apply a fungicide drench, and hold with good ventilation at 63°F. Make frequent checks for uniform moisture and proper temperature. Precooling (vernalization) is a cool-moist process, and requires a full 6 weeks, so reduce temperature to 40°F no later than November 6-13. The schedule below assumes planting around October 24, followed by 3 weeks of warm rooting, 6 weeks of cooling starting on November 14, and a forcing time of about 16 weeks--start to Easter--after moving into the greenhouse December 20-24. The heights given are crop averages, and are based on emergence by January 8, visible bud on March 2-5, and a final height of 21-23" (plant plus pot) at shipping on April 8-11. This gives a total of about 6.5 weeks from the projected visible bud date to Easter…some of which will undoubtedly be in cold storage.

Weeks before Easter	Date	
>24	October 24	Pot in standard depth pot with 1 inch of media below the bulb. Water in to fully moisten the soil, then drench with an appropriate drench to control Pythium and Rhizoctonia. Place in 63°F cooler (for root initiation).
24	October 31	Happy Halloween! Continue warm (63°F) rooting period.
23	November 7	Continue warm (63°F) rooting period.
22	November 14	Start of vernalization. Reset temperature in cooler to 40°F to start vernalization process. Check temperatures in cooler. Double check moisture...bulbs will not perceive the cold temperatures if soil is not uniformly moist.
21	November 21	Start week 2 of cooling. Check cooler temperatures and water pots if necessary. Keep records.
20	November 28	Start week 3 of cooling. Watch for sprouting. If sprouts are present, lower temperature a few degrees. Do not go below 35°F and do not go below 40°F unless sprouting is widespread.
19	December 5	Start week 4 of cooling. Continue to monitor temperatures. Make final plans for greenhouse space, etc.
18	December 12	Start last week of cooling. Clear space for moving pots into the greenhouse. Segregate any sprouted plants if deemed necessary.
17	December 19	Move plants into the greenhouse. This is a late-Easter year (April 16). Start crop with a 60° night and 68°F day temperatures. This will give a

		24-hour average temperature near 63°F, or keep at 63F constant. Only if major problems with inadequate cooling are known, use "insurance lighting" for 2 weeks after crop emerges. Prepare for this now.
16	December 26	Continue these temperatures until emergence. Start feeding program now with 200-300 ppm N. Do not wait. Plant quality will suffer (yellow leaves).
15	January 2	Continue these temperatures until emergence. You should have the beginnings of an excellent root system now. Knock plants out of the pots to check. Plants are emerging.
14	January 9	Most plants are emerged. When more than 50% of the crop is emerged, consider lowering temperature slightly to slow growth.... remember, it's likely to be much brighter and warmer in the last 2 weeks of the crop. You may also have the time in late January to dip temperatures to improve bud count (see below).
13	January 16	Crop is fully emerged. Move any non-emerged plants to warmer areas. Some growers start sorting for uniformity of flowering and growth regulator applications. Start graphical tracking and begin height management depending on the results of the graph. Dissect a few plants for evidence of flower initiation so leaf counting may begin. Now is the time to run the lowest temperature possible from a timing standpoint to increase flower bud count. In no case should you go below 55°F nights. Plants are 7" tall (shoots 1").
12	January 23	Buds are probably initiated. Plants are 8" tall (shoots 2").
11	January 30	Consider A-Rest or Sumagic applications and/or DIF depending on graphical tracking information. Since strong negative DIFs can increase postharvest catastrophic leaf yellowing, zero DIF or morning temperature drop is better as some height control is realized with less chance of leaf yellowing later on. Drench with an appropriate fungicide. Plants are 9" tall.
10	February 6	Space plants as soon as possible. Lilies stretch when crowded. Watch excessively high day temperatures that will stretch plants. High average temperatures now are bad for bud count. Consider a spray application of Fascination at a rate of 10 ppm GA_{4+7}, Direct spray to lower leaves only. Avoid spraying upper parts of the plant, or allowing excessive material to contact the soil (via direct spray or dripping) or stretching will result. Plants are 10" tall.
9	February 13	Adjust temperatures in relation to leaf counting and leaf unfolding rates. Keep a close watch for aphids and spot spray rigorously to eliminate them. Plants are 11" tall.
8	February 20	Since half of the final height is determined by the time of visible bud, it is important to control height by acting on information obtained by graphical tracking. Keeping them short now helps a lot later on. Lilies must be spaced for quality and height control. Again check leaf-unfolding rate. Plants are 12" tall.
7	February 27	First buds visible. Watch height--it can easily get away with increasing sun and warmer daytime plant temperatures. If plants are short or stunted, positive DIF will cause them to grow taller. Watch roots. Check for

		insects. Consider a second fungicide drench. Consider a second spray application of Fascination at a rate of 10 ppm GA_{4+7}. Plants are 13" tall.
6	March 6	Most plants at visible bud. Plants are 14" tall. Consider using a finishing fertilizer of 200-250 ppm N from calcium nitrate (18-22 ox/100 gal). The calcium will promote healthy roots.
5	March 12	All plants at visible bud by now. Slower plants might need to be sorted and warmed slightly. Watch roots. Avoid bad lower leaves by keeping roots healthy (see above), avoiding excessive soluble salts and by proper spacing. Remember, a lily will double in height from visible bud to flowering. Maintain graphical tracks and height control measures. Buds ½-1" long. Plants are 15.5" tall.
4	March 20	Buds 2" long. Use a bud stick. Drench if not done in previous 2 weeks. Plants are 16.5" tall.
3	March 27	Buds 3" long. Double check for aphids. Plants are 18.5" tall. First plants go to a cooler at 35-40°F. If plants are cold stored, make sure 1) soil is moist, 2) that plants had a root rot drench within the last 2 weeks and that Fascination spray application to the leaves and buds at a rate of 25 ppm GA4+7 has been made, and 3) foliage is dry going into the cooler.
2	April 3	Buds 4-5" long. Watch *Botrytis*. Major shipping time for many growers. Plants are 20.5" tall.
1	April 10	Shipping still in full swing. Buds 5+ inches long. Plants 22" tall.
0.5	April 11-13	Last ship dates. Plants are 22" tall. Puffy buds.
0	April 16	Easter Sunday.

Flower Bulb Research Program

2006 Home case cooling

Stack cases of uncooled bulbs in a 45°F cooler, arranging for good air circulation. Bulbs require 6 weeks of "cold-moist" treatment for proper flowering. After the peat surrounding the bulbs reaches 45°F or below, it is helpful to add 1 quart of cold water to each case. This replenishes water lost from the cases during shipping. Since vernalization requires moisture, and cases lose water during shipping and storage, the additional water helps keep the peat moist and increases vernalization uniformity throughout the case. Whether bulbs are received earlier or later than this schedule, place immediately into the cooler, and plant after bulbs have been exposed to 6 weeks of 40°F temperature. Assume receipt and planting 7 November for this schedule, with potting on December 19, and a forcing period of 17 weeks. You should work with bulb supplier if you receive bulbs much earlier or later than this schedule assumes.

Weeks before Easter	Date	
23	November 7	Bulbs placed into the cooler. Check cooler and internal case temperature. Base cooling on internal case temperature of 45°F for a duration of 6 weeks.
22	November 13	Week 2 of cooling. Check temperatures and add cold water to cases necessary to maintain moisture. Make plans for media containing no superphosphate with a pH near 5.8 to 6.5 and containing good levels of calcium and some available nitrate nitrogen fertilizer.
21	November 21	Week 3 of cooling. Watch for sprouting in the cases. If sprouts are present and are 1-2" long, consider lowering temperatures. Do not go below 35°F and do not go below 40°F unless sprouting is serious.
20	November 28	Week 4 of cooling. Continue to monitor temperatures. Make final plans for greenhouse space, media, pots, etc.
19	December 5	Week 5 of cooling. Continue to monitor temperatures
18	December 12	Week 6 of cooling. Clear space in the potting area.
17	December 19	Assuming bulb and peat moss temperatures were satisfactory during cooling, plant into a standard depth pot with 1 inch of media below the bulb. Drench with an appropriate fungicide or combination to control Rhizoctonia and Pythium. April 16 is a late Easter. Start crop with 62°F night and 65-68°F day temperatures.
16	December 26	Continue as above. Only if major questions exist about proper cooling use "insurance lighting" for 1-2 weeks after crop emerges.
15	January 2	Continue temperatures until emergence. White roots should be coming visible in some pots. Start feeding program now with 200-300 ppm N. Do not wait or plant quality will suffer. Keep pots uniformly moist but not wet.
14	January 8	Many plants emerging.
13	January 16	Crop is emerged. Maintaining cool temperatures (56-58°F nights) for 7 to 14 days during flower initiation can increase bud count. Move non-emerged plants to warmer areas. Under no circumstance should warm nights (above 65°F) be used. Reduced bud count and too rapid flowering will result.

12	January 23	Buds are likely initiating. Stem roots become visible at this time also. Dissect a few plants for evidence of flower initiation so leaf counting may begin. Some growers start sorting for uniformity of flowering and growth regulator applications.
11	January 30	Start graphical tracking. Avoid over watering. Drier media encourages root growth, and reduces root rot problems. Plants are 9" tall.
10	February 6	Space plants as soon as possible. Do not try to finish a Valentine's Day crop before spacing lilies; lilies stretch when crowded. Consider a spray application of Fascination at a rate of 10 ppm GA_{4+7}, Direct spray to lower leaves only. Avoid spraying upper parts of the plant, or allowing excessive material to contact the soil (via direct spray or dripping) or stretching will result. Drench with an appropriate fungicide. Plants are 10" tall.
9	February 13	Consider A-Rest or Sumagic applications and/or negative DIF depending on graphical tracking information. Since strong negative DIFs increase lower leaf yellowing, we prefer zero DIF, as some height control is realized with less chance of leaf yellowing later on. Plants are 11" tall.
8	February 20	Follow pot cooling schedule, above.

2006 Commercial cooling

Case cooling (cooling of unplanted bulbs), is done by the supplier. There is a possibility of ice being found in the case. Notify your supplier immediately if ice is found in the cases, or if bulbs are seriously sprouted. Plant immediately! Do not unpack bulbs from the case until ready to plant, to avoid bulbs drying out before planting. Assuming planting 19 November for this schedule, the following dates apply: Emergence, January 9; flower bud initiation, January 20-24, and visible bud, March 5.

Sidebar

Recipes for preparing Fascination solutions. Fascination is a 1:1 mixture of 1.8% gibberellin $_{4+7}$ and 1.8% benzyladenine.

ppm GA_{4+7}/BA	ml/L	ml/gallon	ounces/gallon
10/10	0.6	2.1	0.07
25/25	1.4	5.3	0.18

Flower Bulb Research Program

Sidebar

Leaf counting guidelines

Leaf counting is the major way to time lily crops between flower initiation in mid to late January and the visible bud stage (this year recommended to be March 2-4). In late Easter years, leaf counting is critical to help keep the crop slow enough in the mid phase of forcing so that excessively early crops are avoided. Some guidelines on leaf counting are below.

An early non-destructive check on flower initiation inside the growing point is that is emergence of stem roots, which can be seen about 1" below the soil surface. Around January 15th to 20th, randomly select about 5 plants of each major lot of bulbs. Do not count earlier than mid-January because plants will still be vegetative, and flower buds will not be present. Cut the stems off at the soil line. Count the number of unfolded leaves on each stem. The leaf tip (not the whole leaf!) must be unfolded 45 degrees away from the spindle to be counted.

Now, count the remaining small leaves ("leaves to unfold"), using a needle and dissecting microscope (preferred) or a good hand lens (more difficult). Continue counting all leaves until the growing point is reached. Tiny buds should be visible. If so, then the plant is reproductive, and the number of leaves to unfold can be recorded. At this time, you can also get an early idea of bud count. If buds are not present, the plant was still vegetative and the leaf count on that plant should be disregarded. If other plants are also vegetative, wait a few days, and repeat the procedure, then fill in the table below:

	Estimated date from pot cooling schedule	Your crop
Date you want the crop salable	April 10	
Visible bud date (VB)	March 6	
Date destructive leaf count made (plants 3" tall)	January 20	
Days from leaf counting date to VB date (A)	39	
Average total number of leaves (B)	85	
Number of leaves unfolded to a 45 degree angle on March 6 the VB date (C)	35	
Leaves to unfold from leaf counting date To saleable date (April 10) (D), (calculate as B-C)	50	
Leaf unfolding rate required, leaves/day (D/A)	1.3	

Timing with leaf counting. Once the number of leaves to be unfolded is determined, the degree of forcing difficulty is established. The immature leaves must be unfolded in the time between the leaf counting date and the desired visible bud date (usually five to six weeks before marketing since it takes six weeks to bring a plant into flower from the visible bud stage at 60F night temperature). Keep in mind that buds can be forced much faster than this, especially if the plant is healthy, and with a good root system.

To monitor the rate of leaf unfolding, mark 3-6 average plants from each group of bulbs. With a pen or a hole punch, mark the top-most unfolded leaf. At regular intervals (every 3-4 days) count the number of leaves that have unfolded since the last count. Marking the last unfolded leaf each time makes counting easier. Try not to disturb the plants any more than necessary. Dividing this number by the number of days gives the daily rate of leaf unfolding since the last count. If your unfolding rate is greater than the calculated required rate, then average greenhouse temperatures should be lowered slightly, and vice-versa.