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## Methods And Schedules For Forcing 1991 Easter Lilies

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### I. Introduction:

Easter falls on March 31st in 1991. Palm Sunday is on March 24th. Relatively speaking, this is an early Easter (Table 1). The early date of Easter makes it especially critical to monitor a crop on a regular basis to make sure your lilies flower on time.

Table 1. Dates of Easter Sunday from 1987 to 1992.

Year	Date
1987	April 19
1988	April 3
1989	March 26
1990	April 15
1991	March 31
1992	April 19

### II. General Considerations:

**Flower Induction:** Flower induction in the Easter lily can be achieved with cold

temperatures or long photoperiods. In its native environment, the Easter lily is induced to flower by long days (LD). Wild plants typically flower in August.

Commercial flower induction of the Easter lily is accomplished by exposing bulbs to a 6 week (1000 hours) vernalization treatment followed by a short LD treatment after emergence to insure induction has occurred. Vernalization is a cool-moist treatment. Therefore, it is very important that the media around a bulb is moist. If media is dry, the bulb will not perceive the cold treatment.

**Cooling Methods:** There are 4 commercial cooling techniques which are used to flower Easter lilies. The techniques are:

- 1) natural cooling
- 2) controlled temperature forcing (CTF)
- 3) home case cooling
- 4) commercial case cooling

Methods 1 and 2 cool bulbs in a pot often after plants have been allowed to root for a period of time. In contrast, methods 3 and 4

cool bulbs in a packing case. There are differences in the appearance of plants forced under the different techniques. In general, bulbs cooled through methods 1 and 2 produce a higher quality plant than those produced through methods 3 or 4. However, many forcers find the space requirements of techniques 3 and 4 are prohibitive.

The length of the cooling period is critical. As the length of the vernalization increases:

- shoot emergence occurs earlier
- shoot emergence becomes more uniform.
- \* the time from shoot emergence until flower decreases.
- leaf number decreases
- \* leaf length decreases at the base of the plant
- \* internode length increases
- flower number decreases

Do not cool over 6 weeks! Overcooling tends to decrease plant quality.

**Cultivars:** There are 2 cultivars of Easter lily which are commonly forced: 'Ace' and 'Nellie White'. The majority of the Easter lilies grown are 'Nellie White'. The cultivars vary in their appearance at flower. In general, compared to 'Ace', 'Nellie White'

- \* is shorter
- has fewer leaves
- \* has wider leaves
- \* has more basal leaves
- \* has 1/2 to 1 less flowers
- \* is less pron to tip burn

The cultivars also have different optimal temperatures for cooling. 'Ace' should be cooled at 40°F. 'Nellie White' should be cooled at 40-45°F.

**Media:** The planting medium must be well drained and well aerated. Most forcers grow lilies in a soilless media containing peat and vermiculite. Use perlite sparingly or not at all. Perlite contains fluoride which can cause

'leaf scorch' or tip burn. Some forcers add 10-20% soil to a soilless medium. There are advantages and disadvantages to this:

- 1) media cation exchange capacity or the ability of the media to retain nutrients is increased.
- 2) the soil is better suited for watering with subirrigation systems.
- 3) the soil is more buffered. Therefore, change in media pH over time is often slower.
- 4) the media has less aeration. Therefore, the risk of root rot may be greater.
- 5) media weight increases.
- 6) ammonium may tend to build up to toxic levels if a fertilizer which contains ammonium is used.

**Nutrition:** Maintain medium pH between 6.0 and 7.0. If fluorides are in your water, maintain a higher pH (6.5-7.0) to tie up as much of the fluoride as possible.

Fertilize with a 200-0-200 ppm (N-P-K) solution. Do not use fertilizers which contain ammonium in northern climates.

Do not add superphosphate to the media because it contains fluoride. Supply phosphorus through a starter fertilizer. Phosphorus can also be added to the medium through phosphoric acid treatments if the water pH is being amended with this acid.

### **III. Pest Management:**

**Insects:** The bulb mite, Rhizoglyphus robini, can severely damage the lily bulb during development. Dip bulbs in dicotol (Kelthane) for 30 minutes prior to planting for best control this pest. Experimental trials suggest that Avid applied as a drench or dip or Vendex applied as a drench are the most promising substitutes if Kelthane is not available.

Aphids can also affect Easter lilies. In large numbers they cause leaf and flower distortion. Aphids are often most damaging at the visible bud stage.

Fungus gnats are occasionally a problem when the growing medium stays wet for extended periods of time. Larvae of the fungus gnat can cause root damage when present in large numbers. Use an insecticide drench (e.g. Gnatrol) to control this pest.

**Pathogens:** There are 3 diseases which you as a lily forcer should be aware of: botrytis, rhizoctonia, and pythium.

Botrytis (Botrytis elliptica) is a fungal disease that can cause loss in quality of product. Initial symptoms appear as small faded spots which soon turn light brown on the leaves and/or flowers. The disease is favored by cool temperatures and high humidity. If cool moist conditions are present, a grey mold will develop on the infected tissue. Botrytis requires free moisture and high humidity to develop on the plant. Therefore, one method of control is to ventilate to keep plants dry. In addition, plant debris should be removed to eliminate a source of inoculum. If lilies are to be stored in a cooler, reduce humidity if possible to prevent botrytis from developing on the flower buds.

Root rot is caused by several soil-borne fungal diseases which can be difficult to control. Pythium spp. and Rhizoctonia solani are usually involved in destruction of lily roots. In general, any discoloration of roots from a yellowish white to a brown/black color suggests a root rot problem. It is usually advisable to assume that the potential for root rot always exists. Control of root rot includes use of a well drained potting medium and the use of fungicides applied as preventative drenches. Apply fungicides immediately prior to cooling and when plants are moved into the greenhouse for forcing.

There are several viruses that can affect Easter lilies. These diseases usually can not be controlled and the best advice is to purchase bulbs from a reliable source.



## **IV. Schedules:**

### **Schedule 1, Natural Cooling, Easter 1991**

#### **General:**

a) noncooled bulbs are used. Bulbs should arrive during the first 2 weeks of October, 1990. Dip bulbs for control of bulb mite.

b) Pot bulbs 1/2 to 1 inch from the bottom of the pot. Drench with a fungicide for control of Pythium and Rhizoctonia. Bulbs should be potted on October 8, 1990 to root plants for 3 weeks. Plant bulbs on October 15, 1990 for 2 weeks of rooting. Keep soil moist and at a temperature of 63-65°F for optimal rooting. The rooting period is believed to be responsible for the high flower bud counts often found with this cooling technique. Therefore, the longer plants can be rooted before cooling the better!

#### **Cooling:**

a) Potted bulbs should be placed on a substrate such as gravel to elevate the base of the pot above the surface of the field, covered frames, shed, or uncooled greenhouse. Potted bulbs are then exposed to naturally occurring, fluctuating temperatures. Exact temperature records must be kept. Record temperatures daily. Use thermometers inserted in pots next to the bulbs. Bulbs require 1000 hours of temperatures at 40°F for 'Ace' and 40-45°F for 'Nellie White'. Soil should not be allowed to freeze. Keep soil moist, but not wet. A light mulch or shading over the top of the pots aides in maintaining uniform temperatures and moisture.

#### **Start Of Forcing:**

a) Greenhouse forcing can start after 6 weeks of cooling. Do not overcool! The earliest possible forcing date based on an October 12-16 potting date is November 23-27, 1990. The inability to achieve desired soil temperatures during any time during cooling will delay the beginning of the greenhouse forcing stage. Potted bulbs should be moved into the greenhouse no later than December 8-14, 1990.

b) Soil temperatures should be maintained between 60 and 65°F until January 13-21, 1991. Because Easter is early this year try to maintain a 65°F soil temperature. A warmer soil temperature will hasten emergence. The bulk of your lily population should be emerged by December 24, 1990. Lower temperatures may limit root development. High temperature may delay flower initiation. Flower initiation will not occur until January 13-21, 1991. Do not let air/soil temperatures exceed 70°F!

c) At shoot emergence you may want to place plants under long day conditions to insure that plants have been induced to flower. Expose emerged shoots to long days by placing plants in an area where they will receive 10 footcandles of night interruption lighting from 10:00 p.m. to 2:00 a.m. Because of the potential for shoot elongation when night lighting with incandescent lamps, we recommend that you light for only 1 week unless plants received less than 6 weeks of cooling.

## **Schedule 2. Controlled Temperature Forcing (CTF), Easter 1991**

### **General:**

- a) noncooled bulbs are used. Bulbs should arrive during the first 2 weeks of October, 1990. Dip bulbs for control of bulb mite.
- b) Pot bulbs 1/2 to 1 inch from the bottom of the pot. Drench with a fungicide for control of Pythium and Rhizoctonia. Bulbs should be potted on October 8, 1990 to root plants for 3 weeks. Plant bulbs on October 15, 1990 for 2 weeks of rooting. Keep soil moist and at a temperature of 63-65°F for optimal rooting. The rooting period is believed to be responsible for the high flower bud counts often found with this cooling technique. Therefore, the longer plants can be rooted before cooling the better!

### **Cooling:**

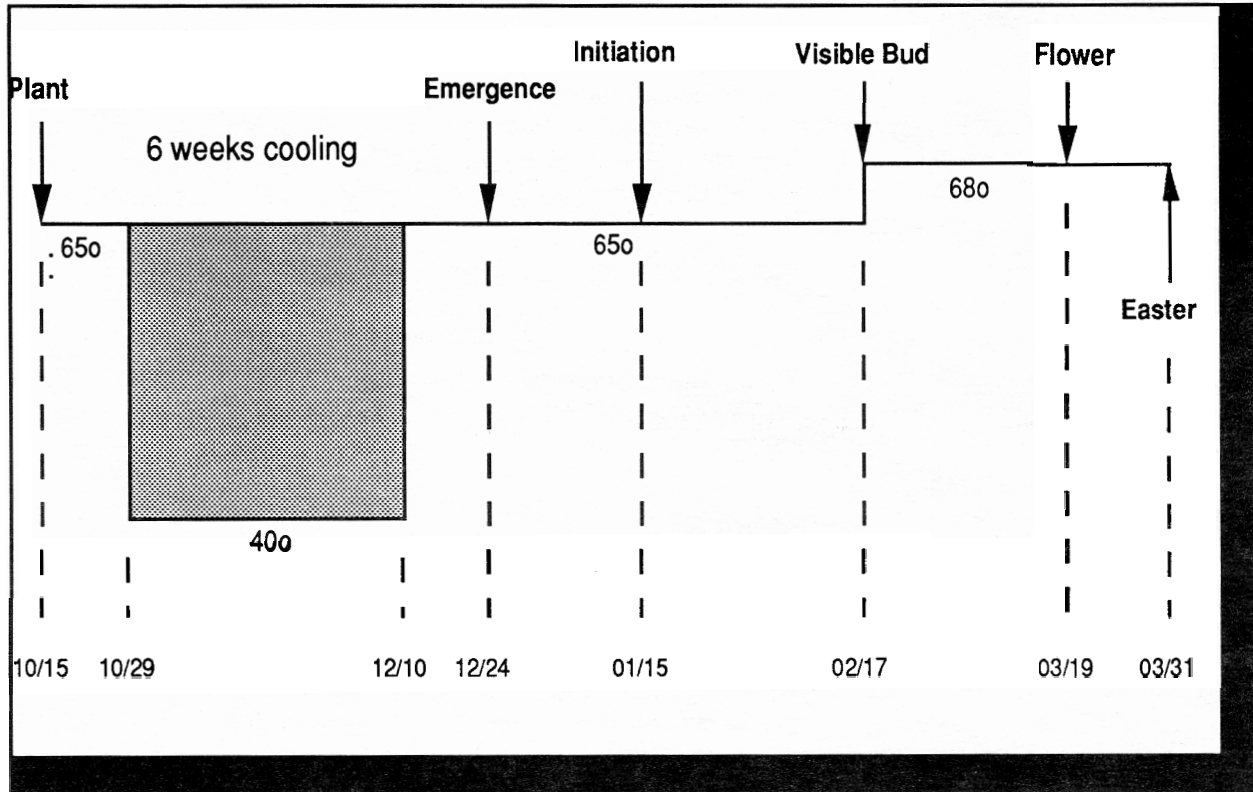
- a) Start cooling on October 29, 1990. Drop the soil temperature to 40°F for 'Ace' and 40-45°F for 'Nellie White' bulbs. Place thermometers in the soil next to the bulbs. Record temperatures daily. Make sure the media is moist at all times; the bulb will not perceive the cooling treatment if the media is not moist.

### **Start Of Forcing:**

- a) Bring potted bulbs out of the cooler after 42 days (1000 hours). This year potted bulbs should be brought into the greenhouse on December 10, 1990. Between December 8, 1990 and Easter Sunday there are 113 days.
- b) Soil temperatures should be maintained between 60 and 65°F until January 13-21, 1991. Because Easter is early this year try to maintain a 65°F soil temperature. A warmer soil temperature will hasten emergence. The bulk of your lily population should be emerged by December 24, 1990. Lower temperatures may limit root development. High air temperature may delay flower initiation. Flower initiation will not occur until January 13-21, 1991. Do not let air soil temperatures exceed 70°F!
- c) At shoot emergence you may want to place plants under long day conditions to insure that plants have been induced to flower. Remember that both cooling and long days can induce an Easter lily to flower. Expose emerged shoots to long days by placing plants in an area where they will receive 10 footcandles of night interruption lighting from 10:00 p.m. to 2:00 a.m. Because of the potential for shoot elongation when night lighting with incandescent lamps, we recommend that you light for only 1 week unless plants received less than 6 weeks of cooling.

## Lily Schedule 1991

### Controlled Temperature Forcing (CTF)



This schedule is an example. Temperatures are based on an Easter lily which has 90 leaves. Actual temperatures will depend on the leaf number per plant of your Easter lily crop and the ability of your greenhouse to maintain temperatures. This schedule was developed in conjunction with Royal Heins at Michigan State University. Forcers who retail their crops directly may cool later and/or force at lower temperatures to flower plants somewhat later.

## Schedule 3. Home Case Cooled Bulbs, Easter 1991

### General:

- a) noncooled bulbs are used.
- b) bulbs should arrive during the first 2 weeks of October, 1990. Make sure that the peat in the crate is moist. If dry, call your supplier. The peat must be moist for the bulbs to perceive the cooling treatment.

### Cooling:

- a) Place the packing crate in the cooler immediately.
- b) Drop the soil temperature to 40°F for 'Ace' and 40-45°F for 'Nellie White' bulbs. Place thermometers in the soil next to the bulbs. Record temperatures daily. Make sure the media is moist at all times; the bulb will not perceive the cooling treatment if the media is moist.
- c) Bring the packing crates out of the cooler after 42 days (1000 hours). This year bulbs should be brought out of the cooler into the greenhouse on December 10, 1990. Between December 10, 1990 and Easter Sunday there are 111 days.

### Start Of Forcing:

- a) Dip bulbs for control of bulb mite. Pot bulbs 1/2 to 1 inch from the bottom of the pot. Drench potted bulbs with a fungicide for control of Pythium and Rhizoctonia.
- b) Soil temperatures should be maintained between 60 and 65°F until January 13-21, 1991. Because Easter is early this year try to maintain a 65°F soil temperature. A warmer soil temperature will hasten emergence. The bulk of your lily population should be emerged by December 24, 1990. Lower temperatures may limit root development. High air temperature may delay flower initiation. Flower initiation will not occur until January 13-21, 1991. Do not let air soil temperatures exceed 70°F!
- c) At shoot emergence you may want to place plants under long day conditions to insure that plants have been induced to flower. Expose emerged shoots to long days by placing plants in an area where they will receive 10 footcandles of night interruption lighting from 10:00 p.m. to 2:00 a.m. Remember that both cooling and long days can induce an Easter lily to flower. Because of the potential for shoot elongation when night lighting with incandescent lamps, we recommend that you light for only 1 week unless plants received less than 6 weeks of cooling.

## Schedule 4. Commercially Case Cooled Bulbs, Easter 1991

### General:

- a) cooled bulbs are used.
- b) bulbs should arrive between November 27 and December 10, 1990. Make sure that the peat in the crate is moist. If dry, call your supplier. The peat must be moist for the bulbs to perceive the cooling treatment. Dry peat suggests that bulbs may not have been cooled adequately and/or have been cooled unevenly.

### Start Of Forcing:

- a) Dip bulbs for control of bulb mite. Pot bulbs immediately after receiving them. Drench potted bulbs with a fungicide for control of Pythium and Rhizoctonia.
- b) Soil temperatures should be maintained between 60 and 65°F until January 13-21, 1991. Because Easter is early this year try to maintain a 65°F soil temperature. A warmer soil temperature will hasten emergence. The bulk of your lily population should be emerged by December 24, 1990. Lower temperatures may limit root development. High air temperature may delay flower initiation. Flower initiation will not occur until January 13-21, 1991. Do not let air soil temperatures exceed 70°F!
- c) At shoot emergence you may want to place plants under long day conditions to insure that plants have been induced to flower. Expose emerged shoots to long days by placing plants in an area where they will receive 10 footcandles of night interruption lighting from 10:00 p.m. to 2:00 a.m. Remember that both cooling and long days can induce an Easter lily to flower. Because of the potential for shoot elongation when night lighting with incandescent lamps, we recommend that you light for only 1 week unless plants received less than 6 weeks of cooling.





## V. Greenhouse Forcing:

a) Flower initiation should occur from January 13-21, 1991. Plants are usually 4-7 inches tall at this stage. Leaf count at least 5 of your lilies after flower initiation. Leaf number varies between plants from year to year, between cultivars, and between plants cooled with different techniques. The average leaf numbers of Ace and Nellie White lilies which have been case cooled and CTF cooled are shown in Table 2. The specifics of leaf counting are discussed in the following article by Royal Heins.

Table 2. Yearly average number of leaves on plants from 'Ace' and Nellie White' 8-9 inch bulbs from 1970 to 1987 cooled in the case or with controlled temperature forcing (CTF).

Year	Cooled in case		Cooled by CTF	
	Ace	Nellie White	Ace	Nellie White
1970	92.3	89.6	104.3	90.5
1971	94.8	69.6	104.0	89.6
1972	96.3	70.3	105.5	90.0
1973	85.0	67.8	94.5	83.0
1974	90.5	80.0	98.8	87.3
1975	83.3	73.8	79.6	77.4
1976	83.5	71.9	87.2	82.3
1977	66.5	56.3	67.0	65.1
1978	71.3	65.6	77.2	74.5
1979	*	*	84.4	79.3
1980	*	*	89.3	69.7
1981	*	*	82.5	76.8
1982	*	*	90.1	70.8
1983	*	*	91.3	76.8
1984	*	*	98.1	83.2
1985	*	*	103.6	93.6
1986	*	*	94.2	86.6
1987	90.0	82.0	101.0	93.0
Average	85.3	72.7	92.5	82.0

b) Greenhouse temperatures will vary depending on the desired rate of plant development needed to flower plants on time. The majority of your lily population should be at visible bud by February 15, 1991, or 32 days after flower initiation. That is not much time! Keep on top of your temperatures!! Leaf count regularly!

c) Refer to the following article on 'Tracking Easter Lily Height With Graphs' to determine the average daily temperature which you will need to flower your crop on time. Also consider tracking your height to insure that you produce a lily crop of a desired height. To convert celsius to fahrenheit use the following formula: °F = (°C x 1.8) + 32.

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