Lower leaf yellowing can be a serious problem on Easter lily. The following report demonstrates the effectiveness of a hormone spray at preventing this problem. This research study was conducted by Susan Morrow as an undergraduate independent study project under the direction of Drs. Bernard Bible and Richard McAvoy.

Leaf Yellowing of Easter Lilies

Susan A. Morrow
1997 University of Connecticut Graduate

Lower leaf yellowing is an annual concern for Easter Lily growers. As the lower leaves yellow and then die, plants develop a leggy appearance that dramatically reduces their attactiveness. In some years this problem can be quite acute. The onset of lower leaf yellowing typically begins as plants approach the visible bud stage. Various conditions promote yellowing including, high salts, low nitrogen, poor aeration (chronic overwatering), and low light (overcrowding).

Research has shown that leaf yellowing of lily can be reduced with spray applications of products such as Promalin, which is a mixture of the hormones benzyladenine and gibberellin in equal amounts. Benzyladenine (BA) is a form of cytokinin, a hormone that can delay or even temporarily reverse the senescence or aging process in plants. We tested Accel, a mixture of ten parts BA and one part gibberellin (G_A), as well as silica (Si) and calcium (Ca) sprays, for their efficacy in reducing yellowing in lilies. Si and Ca sprays were used because both Si and Ca sprays are known to reduce the incidence of poinsettia bract necrosis; a disorder that occurs on aging tissues and is suppressed by BA sprays. In addition, prior studies with cucumbers have shown that the application of Si results in darker green leaves and delayed leaf senescence.

The Study

Case cooled 'Nellie White' lilies were potted in Metro Mix 510 on December 1, 1996, and grown following the 1997 Easter Lily schedule. On January 24, 1997, foliar spray treatments of $CaCl_2$ (160 ppm Ca) and Na_2SiO_3 (112 ppm Si) were initiated and continued at weekly intervals until March 26. The Accel foliar spray was applied only once, February 21, at a rate of 100 ppm BA and 10 ppm GA. In the Si

and Ca spray treatments, the entire plant was sprayed just to the point of excess dripping off the leaves. The BA spray was only applied to the portion of the stem below the flowers. Each treatment was replicated fourteen times. To create an optimum environment for yellowing to occur, plants were arranged pot-to-pot and guard plants were placed around the perimeter of the plot.

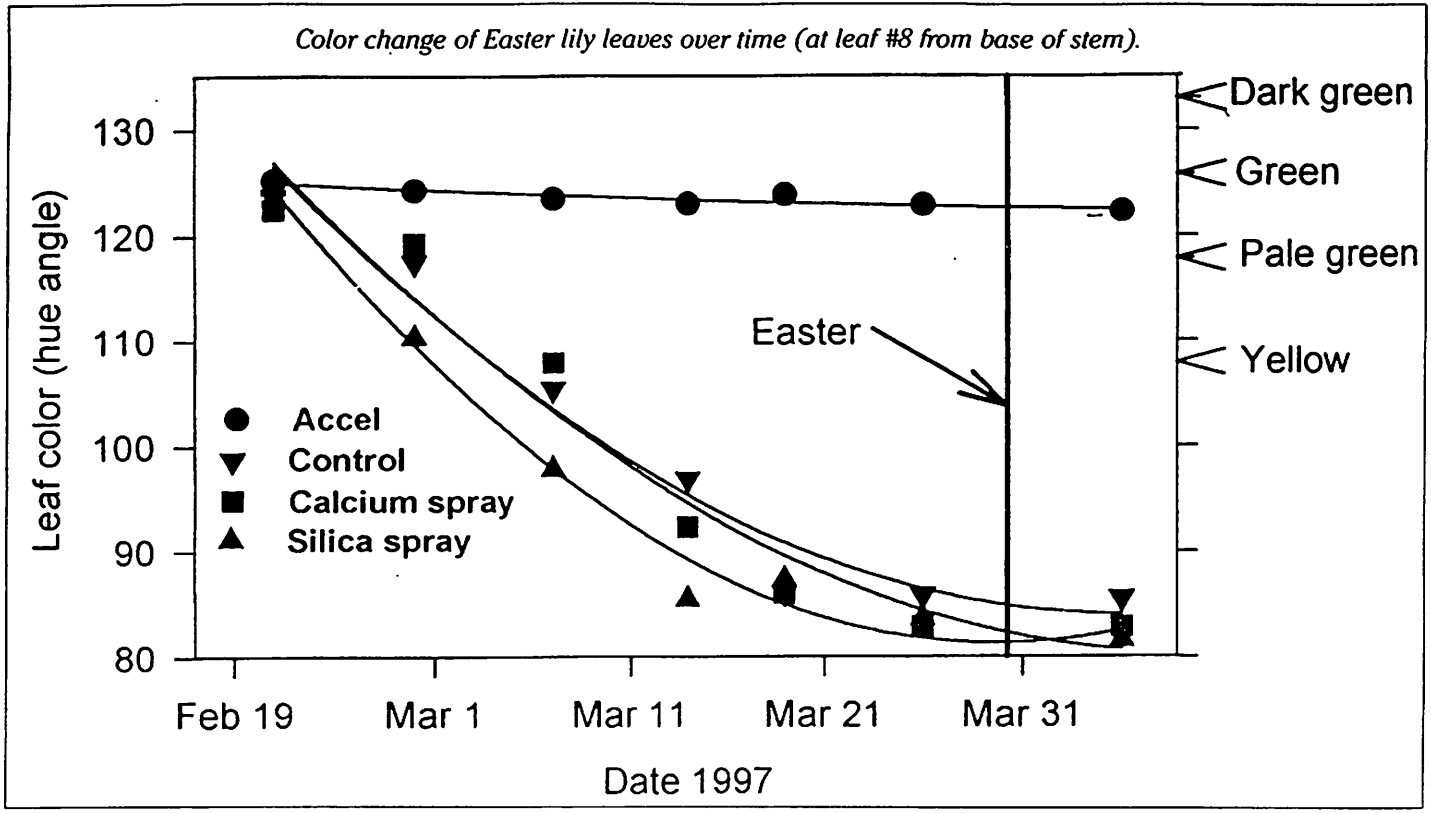
Measuring Lily Leaf Color Change

Changes in the color of leaf numbers 8, 18, 28, and 38 from the base of the plant were measured using a Minolta 200b colorimeter. Values for L*a*b* coordinates were recorded weekly from February 21 to April 4, and hue angle and chroma were calculated from these values. The colorimeter was set to illuminate C and has a 8 mm aperture. Leaves were placed on a white tile background for colorimetric readings. The L value relates to the human response to brightness from black (L-0) to white (L-100). Chroma is a numerical expression of color vividness or purity. The higher its chroma, the more vivid the particular hue. The hue angle shows numerical expression of hue starting at 0° (violet-red) to 90° (yellow), 180° (green), 270° (blue) and back to violet-red at 360°.

Color readings were used to estimate chlorophyll levels in the leaves and to determine if the various treatments were effective in stopping or slowing leaf yellowing. L*a*b* coordinates were measured on each of ten leaves and a corresponding leaf disk was removed with a 9mm-diameter cork borer. Each disk was extracted in 3 ml of N,N-dimethylformamide for 24 hours. Absorbance of leaf extracts was measured using a Shimadau UV160U spectrophotometer. Chlorophyll concentration was determined from the following equation: Chlorophyll (mg/liter) = $17.9\ A_{667} + 8.08\ A_{664}$. A simple linear regression of leaf chlorophyll content (mg/cm2 of leaf area) as a function of leaf chroma ($y = -1.716*\text{chroma} + 85.3$) provided a good fit ($r^2 = 0.99$).

The Results

Si and Ca spray treatments were not effective at preventing leaf yellowing (See graph). At both the 8 and 18 leaf level, plants sprayed with Si and Ca showed the same amount of leaf yellowing as untreated controls. One week after treatment, the Accel sprayed plants showed no sign of yellowing; the hue angle of these healthy green leaves was about 125°, which corresponded to an estimated total chlorophyll content of 37 mg/cm^2. In contrast, the hue angle of leaf number 8 of the controls was 117°, which corresponded to an estimated chlorophyll level of 21 mg/cm^2. This represents a 43% reduction in chlorophyll in one week relative to BA treated plants. Once


Color change of Easter lily leaves over time (at leaf #8 from base of stem).
Leaf color (hue angle)
130
120
110
100
90
80
Accel
Control
Calcium spray
Silica spray
Easter
Dark green
Green
Pale green
Yellow
Feb 19
Mar 1
Mar 11
Mar 21
Mar 31
Date 1997

lilies began to show leaf yellowing, leaf senescence continued at a steady pace until individual leaves died. By the time lilies reached the flowering stage, the lower most leaves on the untreated control, and the Si, and Ca sprayed plants had all yellowed and died, while the leaves on the Accel sprayed plants showed no signs of yellowing.

By the end of the study, control, Ca, and Si sprayed plants all showed measurable yellowing up to leaf 18. However, no yellowing was detected at the 18 leaf level in the Accel treated lilies. None of the treatments developed yellowing on leaf number 28 or 38 during this study.

Summary

Much progress has been made using hormone treatments to combat lower leaf yellowing in lilies. Susan Han (University of Massachusetts) found that gibberellic acid (GA), benzyladenine, ProGibb (containing 500 mg of GA_3), and Promalin (containing 500 mg GA4 + GA7/liter and 500 mg BA/liter) effectively reduce yellowing in lilies. The Promalin treatment was found to the most effective, even at concentrations as low as 50 mg/liter.

One concern with hormone sprays is the tendency for GA to cause stem elongation. While our Accel treated plants were about one inch taller than the controls by Easter, we did not feel that this difference had practical significance. Others have observed deformed flower buds as a result of Promalin sprays, but they were able to eliminate this problem by spraying only the lower half of the plant. In our study, we directed the Accel spray toward the lower portion of the stem and did not observe deformed flowers.

While it appears that Ca and Si sprays have no beneficial effect on this problem, our results confirm earlier reports of the efficacy of sprays with mixtures of gibberellins and cytokinins to combat lower leaf yellowing in Easter lilies.