Is Common Swedish Ivy the Eternal Plant ?

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Summary of this research

The primary goal of my lab is to understand why Swedish ivy recovers repeatedly from nitrogen deficiency when other plants would either lose leaves and/or die. Somehow this plant sidesteps both leaf senescence and death. This is a big picture area and there are many factors that affect the leaf's ability to re-green and avoid the leaf senescence process. These factors include hormones, sugars, enzymes/proteins, and chloroplast presence. The past two years of research funded by the National Foliage Foundation indicates that changes in proteins may be part of the reason why Swedish ivy is unique.

This grant has allowed us to look at the proteins that are present when leaves are nitrogen deprived after being green as well as when leaves re-green after no nitrogen.

Specific research that has been conducted

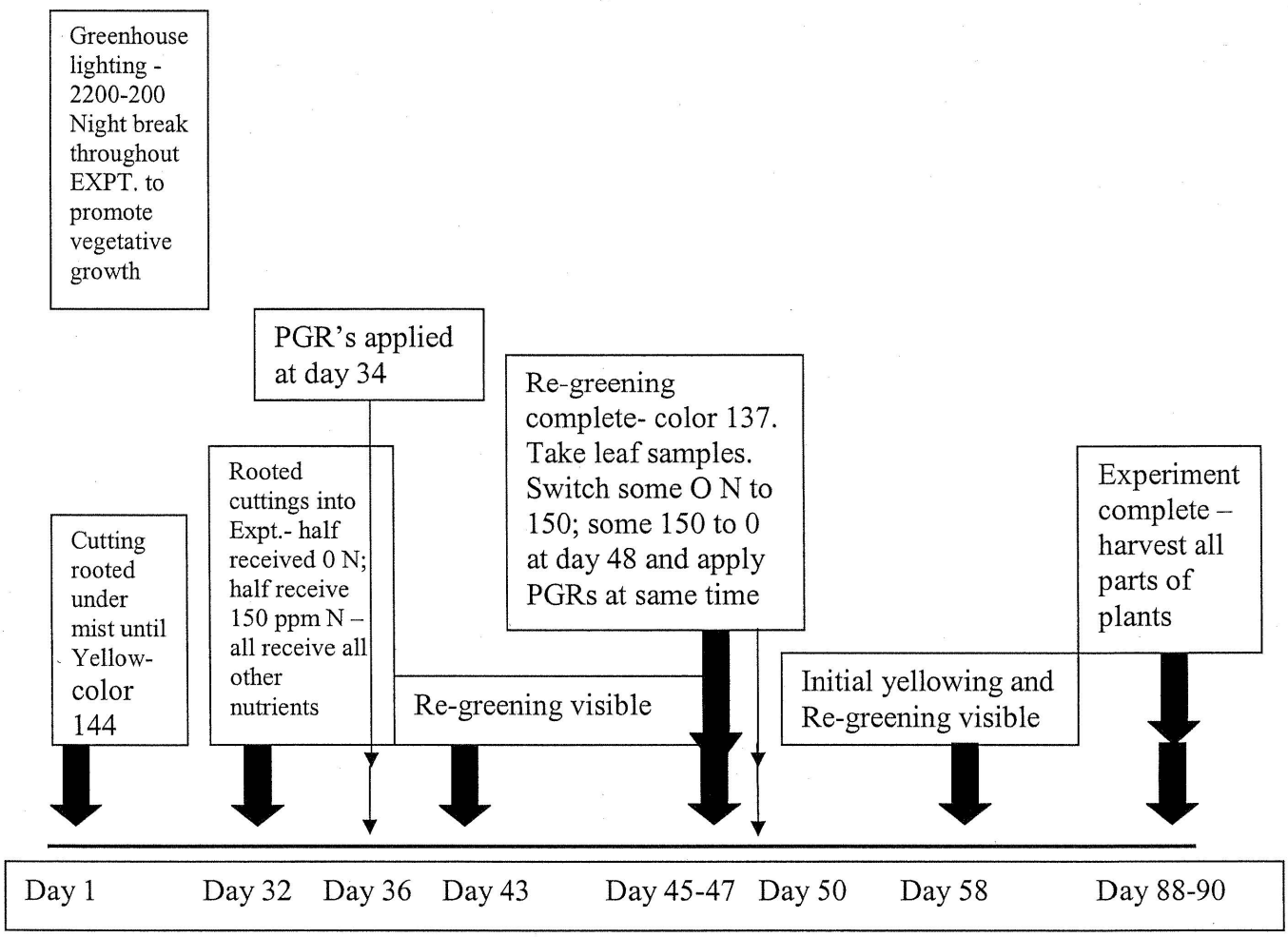
We completed the leaf re-greening experiment in which we are trying to determine whether two cytokinin hormone sprays would over-ride nitrogen deficiency and cause re-greening or allow Swedish ivy to re-green more quickly. As in the background information in the original grant, during leaf senescence there is a decrease in cytokinins. If one could increase the amount of cytokinin in leaves, then leaf yellowing or re-greening will change. There are two commercial products on the market that are being promoted to prevent leaf yellowing in crops such as Easter lily. We obtained these products for our experiment.

In this experiment , we applied either 100 ppm cytokinin or 100 ppm cytokinin plus 100 ppm gibberellin three to five days after either first fertilization of 150 ppm nitrogen or after fertilized plants were deprived of nitrogen and allowed to yellow. There were 6 treatments:

0 mg L^{-1} N
150 mg L^{-1} N
0 mg L^{-1} N +CK
150 mg L^{-1} N+ CK
0 mg L^{-1} N +Ck and GA
150 mg L^{-1} N +CK and GA.

The treatments were applied according to the following timeline.

Experiment Timeline – Swedish Ivy PGR experiment



Results

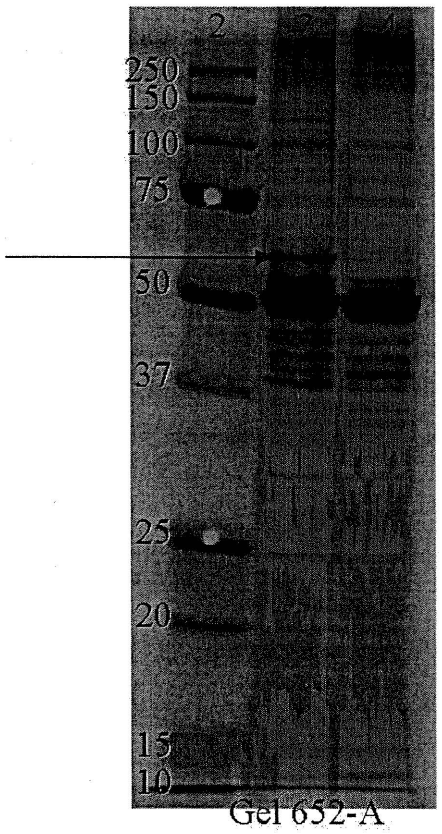
The timeline for re-greening and yellowing of control plants was the same as in our other experiments. Visual evaluations using the RHS color charts confirmed what we saw. The application of these two plant growth regulators did not speed up leaf re-greening on N deficient plants that were given N nor did they slow down the progression of leaf yellowing when a fertilized plant was deprived of N. This is disappointing as it could have been an easy way for growers. However, the protein work was and is more promising.

Proteins

During the first year of this grant, we confirmed that Rubisco was substantially present We did this by running 1-dimensional gels, then taking that gel and running it in a second direction (2-dimensional gels) and then taking a spot from the

appropriate band to be analyzed by mass spectrometry. The results of the mass spectrometry indicated that the predominant protein was Rubisco. So we then obtained an antibody (from Dr. Bob Spreitzer) for Rubisco and were able to run a Western blot. The western blot confirmed the identity of the protein band to be the Rubisco large subunit. At this time, we also noticed the presence of another band (see figure 1) in addition to the Rubisco band at 50 kD.

Figure 1. Lane 2 is the molecular weight ladder from 250 to 10 kDaltons. Lane 3 is a plant that has received no nitrogen and Lane 4 is a plant that has received N.



Lane 2: Dual Color standards

Lane 3: P.a. #13 (13µg)

Lane 4: P.a. #14 (13µg)

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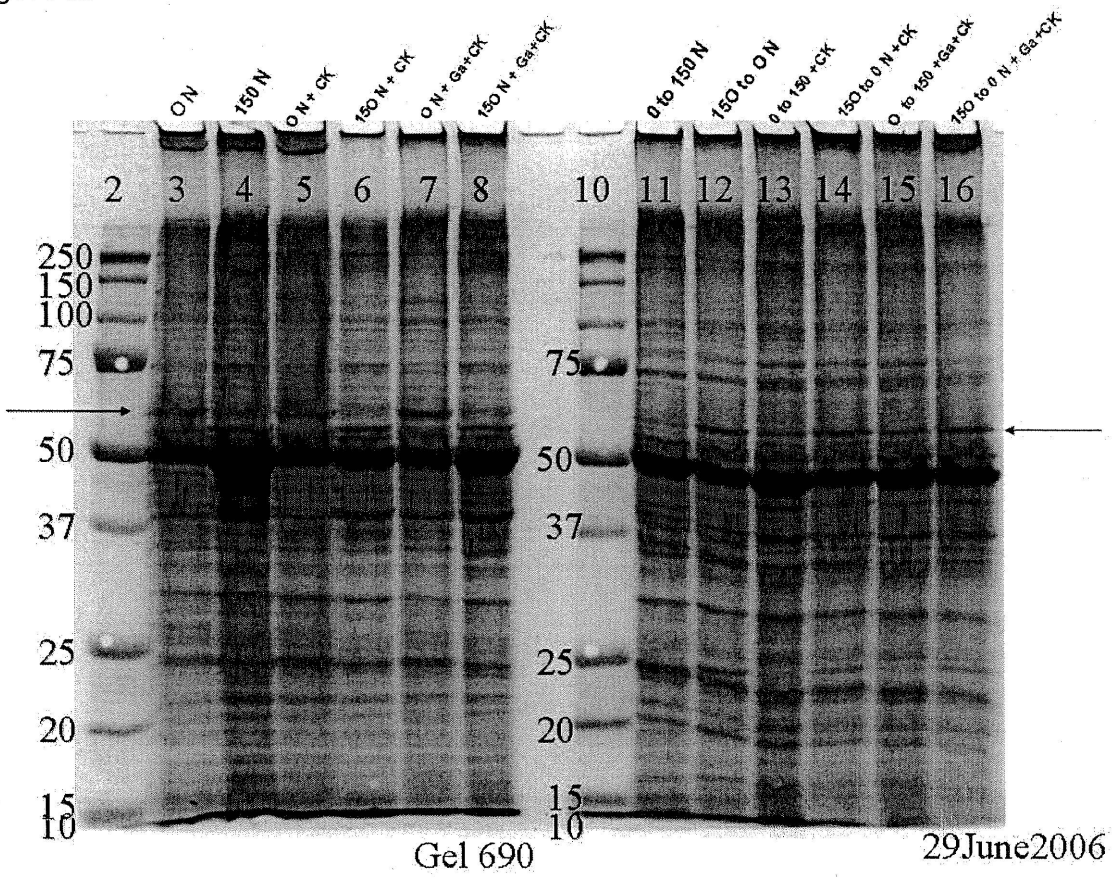
The above band was identified as increasing when the Swedish ivy plants were under N stress regardless of how many times they were previously greened (see Figure 2 below).

Figure 2.



Using mass spectrometry, the band in Figure 2 has been preliminarily identified as containing mainly five proteins – a transketolase, a heat shock protein, a dnaK-type molecular chaperone, a chloroplast envelope membrane protein and a luminal binding protein. We are currently trying to determine which of these is the main one as all five have important roles in the plant. Our current guess is that it is either the transketolase (involved in plant respiration) or the chloroplast envelope membrane protein (to re-green leaves you need to either make chloroplasts or patch up the ones that are present).

Economically, understanding the mechanism for leaf yellowing and re-greening would allow growers to reverse any leaf yellowing that can occurs either during production or shipping of plants. This could allow plants to be shipped further away without sacrificing salability.

highest content of caffeic acid (0.13 mg·g^{-1} dry tissue weight) and 4,5-dicaffeoylquinic acid (0.32 mg·g^{-1} dry tissue weight), respectively.

(185) Genetic Resistance to Crack Development in Processed "Baby" Carrots

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The individually quick frozen "baby" carrot industry is growing. Crack development during freezing (CDF) has recently become a quality issue. There is little scientific information available on the causes of CDF. Studies were initiated to determine genetic resistance for CDF and to identify crack-resistant varieties. Ten varieties and breeding lines (Columbia, HMX-0331, Sugarsnax, Sweet Bites, Tasty Peel, Top Cut, Trinity, XCR-0124, XCR-9650, and XCR-9840) were grown under the same field conditions, harvested identically, and processed. Samples were removed after a quick freeze tunnel and tested immediately for membrane stability using electrical conductivity (EC/g) and a membrane injury index. Percentage cracked, the length, width, and depth of cracks were also measured. Another set of samples were placed in freezer storage at –10 °C for 8 weeks and tested again for the same parameters. EC/g and membrane injury indexes showed significant interactions between variety and length of storage time. Crack length, width, and depth were significantly higher in XCR-9650 and XCR-9840, while Trinity had the smallest dimensions. Crack depths after week 8 in freezer storage were also significantly higher (0.30 cm) than those at week 0 (0.21 cm). Finally, percent cracked was also dependent on the variety and length of storage time. Trinity had the lowest percentage of cracked pieces (16%), whereas XCR-9650 (70%) had the highest percentage of visible cracking. Freezer storage time also played a role in CDF, since cracked percent significantly increased by 4% over the 8 weeks. Our results clearly reveal that there are differences in CDF among varieties. Among all, Trinity had the highest resistance to cracking, comparable to all the varieties except XCR-9650 and XCR-9840.

(186) Fresh-cut Chunks of a New Orange-fleshed Melon Genotype: Analytical and Sensory Comparisons to Its Inbred Parents, and to Commercial Cantaloupe and Green-fleshed Honeydew Harvested in Winter

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A new hybrid orange-fleshed netted melon has been bred specifically for use by the fresh-cut industry in winter. Quality characteristics of fresh-cut chunks from the hybrid were compared to those of its parental lines and to commercial cantaloupe and honeydew fruits available in winter. Female parent and hybrid chunks had higher soluble solids content (SSC) and firmness, and lower aromatic volatile concentrations versus that of the male parent. Hybrid chunks also had higher SSC (>3%) and were firmer (>5 N) than commercial fruit, and showed no appreciable differences in aromatic volatile concentrations to commercial honeydew or in surface color to commercial cantaloupe. Consumers liked the flavor, texture, sweetness, and overall eating quality of the hybrid chunks better than those of its inbred parents and winter honeydew and as well as or better than that of winter cantaloupe. Hybrid fruit stored 5 weeks at 1 °C under modified atmospheric conditions, then fresh-cut and stored 14 d in air at 5 °C maintained good quality (firmness = 51 N, SSC = 12.2%, surface pH = 6.0, beta-carotene and ascorbic acid concentrations = 14 and 182 mg·kg^{-1}, respectively), and showed no signs of tissue translucency or surface pitting despite microbial populations approaching 8 log cfu·g^{-1}. The results indicate that the orange-fleshed hybrid melon is a promising new melon type for fresh-cut processing, especially during the winter.

Poster Session 4—Floriculture Nutrition and Substrates

27 July 2006, 12:00–12:45 p.m.

(67) Effect of Two Types of Fertilizers on the Growth and Development of Tissue-cultured Daylilies Transferred to the Greenhouse

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During Summer 2005, a study similar to that of Summer 2004 was conducted to determine the effect of two type of fertilizers on the growth and development of tissue-cultured daylilies transferred to the greenhouse. Peters 20–20–20 water-soluble fertilizer and a slow-release fertilizer were the two fertilizers evaluated. Peters 20–20–20 fertilizer was used at 0 (control), 50, 100, 200 mg/L rates. The slow-release fertilizer was used at 2.5 g per 10.2-cm pot. Each treatment was replicated four times in randomized complete-block design. After 6 weeks of growth, the results showed that when compared to the control, all treatments except for 200 mg/L caused a significant increase in root growth. Shoot growth was significantly increased by the 100 mg/L treatment, while the 200 mg/L and the slow-release treatments suppressed shoot growth. Similar to the growth of roots and shoots, the 100 mg/L treatment caused significant increase in fresh weight, while both the 200 mg/L and slow-release treatments caused a reduction. Results obtained for Summer 2005 were similar to that of Summer 2004. These results imply that the 100 mg/L Peters 20–20–20 fertilizers treatment is the best treatment for maximum growth and development of tissue-cultured daylilies transferred to the greenhouse.

(68) The Role of Proteins in Leaf Re-greening

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Common swedish ivy plants when exposed to nitrogen (N) stress display typical nitrogen deficiency symptoms such as reddening of stems and petioles and yellowing of leaves. When N levels are restored, leaves of swedish ivy plants will re-green without leaf loss. An experiment was conducted to determine how proteins change when leaves were re-greened after N deficiency. Cuttings of *Plectranthus australis* were rooted under mist and allowed to yellow. Plants were then potted up and fertilized with one of two treatments: complete nutrients with N at 150 ppm or complete nutrients with 0.8 ppm N. The experimental design was a randomized complete-block design with six blocks. Each block had the two N treatments and six plants per treatment. After 3–4 weeks, all plants in the 150-ppm N treatment had re-greened and leaf samples for protein analysis were taken. Plants in four of the six blocks were then switched to the other treatment. After leaves had re-greened once again, leaf samples were taken and the experiment was terminated. Two-dimensional polyacrylamide gel electrophoresis was used to compare the treatments. No obvious differences in protein absence or presence were noted. However, Rubisco appeared to be differentially expressed between the two treatments. 2-D gel analysis with subsequent Western blots showed that for most of the leaf samples, the large subunit of Rubisco (56kD) was quantitatively about 1.3 times more concentrated in the N-deficient plants and possibly modified. The small subunit (12kD) was not reliably detectable. Additional protein results for repeated leaf re-greening and the role Rubsico may play in leaf re-greening will be discussed.

(69) Use of Hypochlorous Acid for Treatment of Greenhouse Irrigation Water

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Scaling from dissolved and suspended solids in irrigation water reduces the efficiency of greenhouse irrigation systems. Water deposits inside