Improving Postharvest Life of Potted Plants and Cut Flowers through Use of Molecular and Applied Technologies

PRINCIPAL INVESTIGATOR:
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PROJECT OBJECTIVES:
Improved flower quality and vase life would benefit floricultural product sales in the United States. Postharvest losses and/or short vase life often result from a combination of premature leaf and flower senescence and abscission, infection by the fungal pathogens, *Botrytis cinerea* and germplasm that lacks desirable postharvest qualities. Our objectives are: 1. To determine the utility of thidiazuron (TDZ), a non-metabolized cytokinin, in extending the display life of cut flowers and potted flowering plants; 2. To characterize the basic biology of *Botrytis*-rose flower interactions to facilitate development of effective disease control measures, and evaluate GRAS (*G*enerally *R*ecognized *A*s *S*afe) chemicals since they offer a cost effective and environmentally friendly alternative to current conventional fungicides; 3. To use molecular and genetical approaches to characterize regulatory genes and gene products that mediate flower senescence and abscission. This provides a foundation for the development of diagnostic molecular indicators of 'freshness' for cut flowers and for analysis of effects of loss-of-function of these genes on the regulation of senescence. The integrated nature of this project enhances the quality and longevity of flowers, leading to greater industry-wide profitability.

ACCOMPLISHMENTS:

1. Thidiazuron (TDZ), a non-metabolized cytokinin, shows promise in extending the life of cut flowers and potted plants. Leaf yellowing, a symptom of senescence, is a significant quality problem in a wide range of potted plants, and also reduces the quality, value and vase life of cut flowers. Previous studies have shown that TDZ, a compound with potent cytokinin activity, dramatically reduced leaf yellowing in cut flowers such as alstroemeria. By working closely with the floriculture group at the University of California-Davis and with growers in California, we have been extending this TDZ application into potted plants. Our data show that leaves on the TDZ-treated potted plants were still dark green while leaves on the control plants were yellowing, even abscised. We also found that a postharvest pulse with TDZ prevented leaf yellowing and extended flower life in Iris flowers. Treating flowers with TDZ in combination with GA_3 further increased floral shoot growth and led to more complete flower opening. Our results indicate significant potential for TDZ as a tool to improve the postharvest life of cut flowers, potted flowering and foliage plants.

2. Investigate alternative means for controlling of botrytis infections. Floral product damages caused by *Botrytis* infection are perhaps one of major quality problems facing U.S. flower growers during transportation and storage. We are attempting to develop effective and environmentally-sound treatments to protect cut flowers against infection by *Botrytis* using chemicals that are generally recognized as safe (GRAS). Our screening study has proven successful in that we identified several highly promising fungistatic compounds with potential for use as alternative treatments for the control of *Botrytis* disease. For example, we tested a chlorine-based oxidizer for its ability to control *Botrytis* infection on cut rose

flowers. Dipping flowers in the oxidizer significantly reduced *Botrytis* development. These results highlight the potential of this simple and safe biocide for reducing postharvest *Botrytis* infection on rose flowers. We also found that the efficacy of the fungicide to prevent *Botrytis* infection on rose flowers was greatest when fungistatic compounds were applied at about 6 hours after harvest. These data indicate the opportunity to optimize the effectiveness of our relatively benign biocides, by treating the fungus when is at its most vulnerable development stage. In addition, we investigated alternative means of postharvest control of *Botrytis* in common cut rose varieties using existing fungicide. Application of Switch showed dramatically reduced *Botrytis* infections in rose as a postharvest drench.

3. Functional analysis of regulatory genes associated with flower senescence and abscission by Virus-induced gene silencing (VIGS). We have been used VIGS as a tool for evaluating the possible regulatory role of a number of transcription factors in leaf and flower senescence and abscission. The genes encoding transcription factors were identified from a public database and cloned from cDNA libraries of petunia and tomato. The time to pollination-induced petal wilting was increased by silencing a petunia homolog of a *MADS-box* gene while silencing of *NAC* type of transcription factors accelerated flower senescence. These results suggest the possibility that, as in leaf senescence, floral senescence is the result of a regulatory network. We are continuing to investigate a large numbers of so-called 'transcription factors' to identify a 'master switch' protein that may be the key to regulate floral longevity. In addition, we are using VIGS to test the effects of silencing abscission zone (AZ)-specific genes, especially those that have been suggested to have a regulatory function. In addition, we have stably transformed petunias with target genes that seem to be of potential importance in floral senescence. These longer-term research will benefit the industry in the longer term, providing more effective means of increasing the life, especially, of short-lived flowers such as iris.

TECHNOLOGY TRANSFER/IMPACT:
In the postharvest handling of ornamentals, premature senescence and abscission often results in significant loss of quality and longevity. To overcome these problems, many crops are treated with chemicals to delay or prevent senescence and abscission. Although these treatments provide an interim solution to the senescence and abscission problems in ornamentals, the long-term solution is in the development, through conventional or molecular breeding, of cultivars not prone to senescence and abscission. The information obtained in this study leads to increased understanding of the regulation of plant senescence, especially flower senescence and leaf abscission. It provides tools to aid in breeding long-lasting flowers and for modulating the senescence and abscission in horticultural crops. Identified genes and gene products that mediate flower senescence and abscission will be exploited and incorporated into biotechnology and breeding programs. Improved and environmentally benign control strategies for *Botrytis* will contribute to enhanced product quality and greater profitability. Our work resulted in publications in refereed journals, book chapters, proceedings, and trade journals.

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