PHYSIOLOGICAL AND HORMONAL FACTORS RELATED TO LONGEVITY OF FLOWERING POTTED PLANTS

Terril A. Nell and James E. Barrett
Environmental Horticulture Department
University of Florida
Gainesville, FL 32611
1992

This project will investigate the physiological factors that affect decline of flowering potted plants indoors. These factors involve production practices, shipping and handling procedures, and indoor environment as related to the grower, wholesaler, retailer and consumer as related to internal changes in sucrose, glucose and fructose. Our new greenhouse/laboratory facilities have thirteen environmentally controlled interior simulation rooms for conducting postharvest research on floriculture crops. This project has provided information on the differences in longevity for several chrysanthemum and poinsettia cultivars, the influence of fertilization and light level during production on longevity and the importance of proper shipping and holding environments for several floriculture species. Also, flower respiration after 17 days indoors has been related to longevity of several chrysanthemum varieties, Our objective is to identify physiological parameters related to increased longevity. The long range benefit of this work is that all the industry will have a better understanding of how to produce and handle floriculture crops to provide a more desirable product that will last longer for the consumer.

INTRODUCTION AND BACKGROUND INFORMATION

Quality will characterize business success in the 1990s, according to numerous consumer and marketing experts. The floriculture industry is no exception! Flowering plants are in direct competition with a multitude of other discretionary purchase items, and if floral sales are to increase, consumers must be satisfied with the flowers they buy.

In today's market, florists and mass market buyers are demanding flowering plants that demonstrate increased performance, as well as attractive physical characteristics. Repeat consumer purchases are discouraged by flowering plants that fade, wither and die under ordinary interior conditions. So emphasis in the 1990s will focus on producing plants that are durable, resilient and long lasting, as well as beautiful. Today, 75 percent of pot mums are sold through supermarkets, according to a recent study by Yoder Brothers. Floral buyers consider in-store and in-home keeping quality to be among the most important attributes in floral products.

Variation in production practices results in considerable variation in longevity of flowering potted plants produced by different growers. Modifying production and handling practices can improve flowering plants for the consumer. Production environment, cultural practices and variety significantly impact longevity and quality. Growers manipulate production temperature and light levels to maximize root development, increase branching and - with the use of DIF (relationship of day and night temperatures) - control plant height, thus ensuring good production quality. Research has demonstrated that growers can also use some cultural and environmental conditions to increase postproduction quality and longevity.

REVIEW OF SIGNIFICANT LITERATURE

Good growers build quality into their plants from the time they select varieties until they ship plants from the greenhouse to the retail store. Each decision about variety selection, cultural practices, production environment, storage, transport conditions and retail environment can have a major impact on plant longevity. Quality is achievable by establishing the factors and conditions affecting quality and then incorporating these specific criteria into production protocols. Achieving quality doesn't

necessarily mean increasing cost.

Growers can virtually assure flowering potted plant longevity by selecting varieties known to tolerate low interior light conditions well. More resilient varieties have less bud and leaf drop and leaf yellowing and increased flower longevity under interior conditions when compared to other varieties (9). Interior longevity of chrysanthemum varieties, for instance, may vary by as much as two weeks due to leaf yellowing, flower fading or decline (13). Similarly, poinsettia leaf drop varies from 20 to 90 percent over a 30-day interior period depending on variety (11).

Production practices have long been oriented toward producing plants sized to respond to designated markets. Product size will continue to be important. But growers should be simultaneously modifying environmental conditions and production practices to increase longevity, as well. Modifying environmental conditions to improve interior longevity doesn't necessarily mean incurring additional production costs. Reducing temperatures during the final two to three production weeks intensifies flower and bract colors. If DIF is used to control plant height, use of either a zero DIF or a slightly positive DIF during the final two to three production weeks is best to enhance longevity (15). High night temperatures during the final 2-3 weeks of a poinsettia crop may contribute to bract edge burn since these temperatures promote rapid bract enlargement.

Production light levels are also important in extending flowering potted plant longevity (5, 9, 15). Unlike potted foliage plants where a low light acclimatization period reduces leaf drop, work in the United States and Europe has demonstrated that high light levels reduce bud drop and increase interior performance of chrysanthemums, Christmas begonias, poinsettias and other flowering plants (5, 9). Symptoms of low production light levels include more flower and bud drop, premature cyathia drop and shortened interior longevity. In the northern United States, using high intensity lighting to optimize longevity during the winter months may be essential to obtain plant size, as well as to develop a plant with good longevity.

Fertilization practices affect longevty, also (6, 7, 8, 10, 12, 16). Reducing fertilizer levels increases longevity without affecting plant marketability. In many cases, the amount of water applied at each watering necessitates high fertilizer levels. Reducing fertilizer level is difficult for some growers to accept initially, but growers who have lowered fertilizer levels have increased postproduction longevity without detrimental effects on crop marketability.

Our program at the University of Florida has investigated effects of terminating fertilizer during the final two to three production weeks (8). Stopping fertilizer applications during the final production stages increased chrysanthemum longevity and reduced incidence of bract edge burn of Gutbier V-14 Glory poinsettia (12). With Easter lilies, however, preliminary work has indicated that fertilizer termination isn't beneficial, so fertilizer applications must be continued until this crop is marketed to avoid premature leaf yellowing. Success of fertilizer termination for each grower is determined by fertilizer levels used, growing media and crop. Growers currently using high fertilizer levels throughout the entire production period will experience greater benefits than growers already using optimum fertilizer levels or reducing fertilizer levels at the end of the crop. Basically, terminating fertilizer reduces the soluble salt level in the growing medium and prevents excessive elemental (salt) buildup in the plant. Nitrogen and potassium sources used in fertilizer programs also affect longevity. Longevity of most flowering potted plants is greatest when 60 to 70 percent of the nitrogen is from nitrate sources and the remainder from either ammonium or nitrate sources (Roude).

Also, some growers have altered the nitrogen-to-potassium ratio at the end of the crop to extend longevity. There doesn't appear to be any benefit from this procedure, but it may be beneficial to switch from fertilizers containing ammonium nitrogen and low calcium and potassium nitrate during the final

two to three production weeks.

Growing medium also influences postproduction performance of flowering potted plants. The medium should provide good aeration and nutrient holding capacity during production and maximum water holding capacity during postproduction to minimize drying out during retail and consumer phases. Wetting agents applied at time of marketing allow for uniform watering during postproduction thus, reducing moisture stress and increasing longevity.

The research results summarized above demonstrate that growers have numerous opportunities to improve longevity of flowering potted plants. However, specific cultural modifications depend on plant species and variety. Thus, it is imperative that the physiological and hormonal changes involved in these responses be better understood so that recommendations can be made for a large number of plant species.

For instance, in cut flowers, use of a sugar based preservative is nearly a universal recommendation due to increased carbohydrate supply to the flower. Similarly, light compensation point has been a useful indicator of the interior performance of foliage plants. In flowering plants, hormonal control of bud/flower drop in some species has been related to ethylene (1, 2, 3, 4) but the role of carbohydrates is unclear. In our previous work with hibiscus, poinsettia and chrysanthemums, carbohydrate levels were not strongly related to flower longevity or bud drop. However, respiration of chrysanthemum flowers was correlated with flower longevity after 17 days under interior conditions - the longest lasting varieties had the lowest respiration levels. These results with chrysanthemum suggest a role of carbohydrates even though levels of non-structural carbohydrates in long and short lasting varieties were similar. Carbohydrate levels may be an indication that 1) sugars are not being translocated from leaves and stems to the flower, 2) sugars have little, if any, significance in flowering plant longevity, or 3) presence of threshold levels in certain varieties which allow long lasting varieties to more efficiently utilize available sugars. Identification of the factors involved in flowering potted plant longevity will advance the industry's ability to provide better quality, longer lasting plants to the consumer.

OBJECTIVES

1. To relate physiological parameters (photosynthesis, dark respiration, carbohydrate levels, etc) to increased longevity of flowering potted plants. 2. To identify cultural practices which improve flowering potted plant longevity, as related to physiological or hormonal changes.

MATERIALS AND METHODS

A number of studies will be conducted with chrysanthemum, poinsettia and potted rose as part of this project. Plants will be grown in a fiberglass, fan and pad cooled greenhouse, or in air conditioned greenhouses at the University of Florida, Gainesville, using standard commercial production practices for each crop.

A. Factors related to cyathia bud drop Our work over the last 2 years has related some differences in sucrose, fructose and glucose levels in 'Annette Hegg Lady' and 'Gutbier V-14 Glory' to cyathia chop, but a strong relationship was not present. In the current study, we will expand this work using additional poinsettia varieties and production conditions to further identify the factors involved in cyathia drop.

1. Poinsettia plants will be grown to anthesis, then moved to our interior rooms at standard conditions of 70 ft-c., 12 hours daily and 70'F and 55% relative humidity. Carbohydrate and starch levels will be

related to cyathia bud drop at each sampling time. Cyathia, leaf, stem and bract tissue will be collected at anthesis and weekly after plants are moved into interior conditions. Samples will be oven dried at 70'C and then ground in a Wiley Mill. Sugars will be extracted from the ground tissue by boiling in an 80% ethanol solution for 20 minutes. The separation of fructose, glucose and sucrose will be performed by gas chromatography techniques using trimethylsilylation derivatives.

2. Poinsettias 'Lilo', 'Subjibi' and 'Freedom' will be grown at 65'F night/75'F day and 72'F night/82'F day from planting to anthesis. Cyathia buds will be collected and analyzed for carbohydrates as outlined above. Cyathia bud drop will be determined weekly after plants are moved indoors.

B. Relationship of Production temperature to carbohydrate levels and longevity

Chrysanthemums 'Tara' and 'Boaldi' will be grown at 65'F night/75'F day or 72'F night/82'F day from planting to flower. At flowering, flower, stem and leaf samples will be taken for analysis of sucrose, glucose and fructose using procedures outlined above. An additional group of plants will be moved to interior rooms for evaluation of longevity. This study will be repeated and additional samples taken for carbohydrate analysis, pending the results of the first study.

C. Relationship of Supra-optimal carbohydrate levels to longevity

Potted roses and carnations will be grown to marketable stage then moved to interior rooms. Carbohydrate levels will be boosted in the plants by injecting sucrose into the stems either 1) during the final 2 weeks of production, 2) during the entire interior period, 3) a combination of 1 and 2 or 4) no additional sucrose. Carbohydrate levels, flower respiration, bud drop and flowering longevity will be determined

FACILITIES AND EQUIPMENT AVAILABLE

The Environmental Horticulture greenhouses, laboratories, and interior simulation rooms will be used for this project. Laboratory facilities include 13 environmentally controlled postproduction rooms, 5 rooms for simulated shipping, and equipment for photosynthesis and respiration measurements, carbohydrate analysis and colorometric procedures.

BUDGET

This project will include our work (T. A. Nell and J. E. Barrett), R. T. Leonard (state supported biological scientist assigned to Terril Nell), and two Doctoral students.
Supplies, greenhouse and interior space, laboratory chemicals $6000
Labor for assistance in growing plants, analyzing plant tissue,
and taking and analyzing data 9000
New columns/parts for gas chromatograph 1500
TOTAL 16,500

REFERENCES

1. Agnew, N. H, M. L. Albrecht and R. K Kimmins. 1985. Reducing corolla abscission of Streptocarpus X hybrids under simulated shipping conditions with silver thiosulfate. HortScience 20:118-119.
2. Cameron, Arthur C. and Michael S. Reid. 1983. Use of silver thiosulfate to prevent flower abscission from potted plants. Scientia Horticulturae. 19: 373-378.
3. Hammer, A., R. Larson, M. Reid, J. Sacalis, M. Saltreit, and G. Staby. 1981. How to reduce

petiole bending of poinsettia plants. Ohio Florists' Assn. Bull. 626.
4. Halevy, A. H. and A. M. Kofranek. 1976. The prevention of flower and leaf abscission in pot roses during simulated transport. J. Amer. Soc. Hort. Sci. 101:658-660.
5. Nell, T. A., J. J. Allen, J. N. Joiner, and L. G. Albrigo. 1982. Light, fertilizer and water level effects on growth, yield and nutrient composition and light compensation point of chrysanthemum. HortScience 6:222-223.
6. Nell, T. A. and J. E. Barrett. 1984. Postproduction longevity of flowering potted chrysanthemums as affected by simulated shipping and holding room temperatures. HortScience 19:567.
7. Nell, T. A. and J. E. Barrett. 1984. How to control bract necrosis. Greenhouse Grower. 2:42, 44, 56, 57.
8. Nell, T. A., M. T. Leonard and J. E. Barrett. 1989. Fertilizer Termination Affect Longevity of Potted Chrysanthemum. HortScience 24:996-999.
9. Nell, T. A., M. T. Leonard and J. E. Barrett. 1990. Production and Post-Production Irradiance Affects Acclimatization and Longevity of Potted Chrysanthemums and Poinsettias. J. Amer. Soc. Hort. Sci. 115:262-265.
10. Nell, T. A. 1990. Commercial transport of flowering potted plants. Grower Talks 53(9):24-39.
11. Nell, T. A. and J. E. Barrett. 1990. Flowering Potted Plants, Maximizing Longevity. SAF. October 20-22.
12. Nell, T. A. and J. E. Barrett. 1991. Plan now to eliminate bract edge burn in your '91 poinsettias. GrowerTalks 54:18-19.
13. Nell, T. A.. 1991. How to make long lasting top performers out of your pot mums. GrowerTalks 54:67-80.
14. Scott, L. F., T. M. Blessington, and J. A. Price. 1984. Influence of controlled release fertilizers, storage duration and light source on postharvest quality of poinsettia. HortScience. 19:111-112.
15. Staby, G. L. and A. M. Kofranek. 1979. Production conditions as they affect harvest and postharvest characteristics of poinsettias. J. Amer. Soc. Hort. Sci. 104:88-92.
16. Wesenberg, B. G. and G. E. Beck. 1964. Influence of production environment and other factors on the longevity of potted chrysanthemum flowers (Chrysanthemum morifolium Ramat.) Proc. Amer. Soc. Hort. Sci. 85:584-590.