Can We Really Make a Difference in Shipping and Handling?

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Abstract

In order for shipping and handling techniques of cut flowers to make a real difference, a significant increase in quality or vase life must be achieved. If research results are to be accepted by the industry, only those procedures or practices that result in at least a 2-3 day increase or more in vase life or significant improvements in quality should be recommended to the industry. Often products or equipment are developed and marketed without a clear value to the vase life or quality of flowers. As an example, we tested vacuum cooling on the vase life of several cut bulb species. The flowers were commercially precooled or vacuumed cooled and then shipped overnight to the University of Florida to simulate the new market trend of sending flowers overnight directly to consumers. Temperature decreased more rapidly when vacuum cooled and temperatures remained lower during most of the transit time in vacuum cooled boxes compared to precooled boxes but only a 1-day increase in longevity was found in one variety of lilies and tulips. No differences in vase life between the cooling methods were found in hyacinth, freesia or iris. In this case, the minor difference in vase life did not demonstrate a substantial benefit in vacuum cooling over precooling cut flowers.

INTRODUCTION

The importance of temperature in postharvest physiology is unquestioned (Nell and Reid, 2000). Temperature may be the most important factor, other than cultivar, influencing postharvest longevity and quality of flowers (Kader, 1992). With most flowers, except for tropical flowers, the closer storage and shipping temperatures are maintained at 0°C, the longer flowers last and many of the physiological factors limiting quality, i.e. respiration and ethylene, are greatly minimized. As the distance and the delivery time of flowers have increased in today's world production market, the challenge has been proper cooling following harvest and maintenance of temperature during storage, handling and shipping.

Precooling techniques were developed in the 1970's and use forced-air cooling to cool packed flowers within 30 – 45 minutes. This can be achieved when flowers are properly packed and the precooling system is operated for adequate times (Kader, 1992). Failure to cool long enough results in higher than desired temperatures. Vacuum cooling, based on the evaporation of moisture to drop temperature, is used to rapidly cool some fruits and vegetables to enhance their quality and shelf life. Limited research is available on vacuuming cooling effects on fresh cut flowers. Brosnan and Sun (2001) showed little value of vacuum cooling cut lilies unless the flowers were sprayed with water prior to cooling to compensate for water loss. These researchers found that spraying with water added only 1.5 days to the vase life compared to non-vacuum cooled flowers. This marginal increase may not be significant enough to justify the cost and investment of a vacuum cooling system. A commercial grower in the USA using vacuum cooling prior to sending flowers for overnight delivery to consumers in uncontrolled conditions was interested in determining the benefit of this cooling technique. This study compared precooling and vacuum cooling methods on the vase life and quality on several cut flower bulb species.

MATERIAL AND METHODS

Lilies (cultivars 'Stargazer', 'Kyoto', 'Royal Danlarifin', 'Prato'), tulips (cultivars 'Ille de France', 'Don Quichotte', 'Negritta'), hyacinth (cultivar 'Blue Giant'), freesia ('White Su') and iris were harvested, hydrated, then bunched and placed into cardboard boxes prior to cooling. Half of the flowers were precooled while the other half was vacuum cooled using standard techniques. Flowers were shipped overnight to the University of Florida in uncontrolled conditions (FedEx Corp., Memphis, TN) to simulate the new market trend of sending flowers overnight directly to consumers in uncontrolled conditions. Temperature recorders (HOBO® H8, Onset Computer Corp., Bourne, MA) were placed in boxes and the temperatures were recorded every 5 minutes. Flowers arrived 24 hours after being cooled.

Flowers were removed from the boxes upon arrival, cut dry and placed in vases containing floral preservative (Floralife Crystal Clear, Floralife, Inc., Walterboro, SC). Flowers were placed in postharvest rooms maintained at 21°C and 10 µmol $m^{-2}s^{-1}$ (12 h/day) for evaluation. Relative humidity was maintained at 50±5%. Vase life and quality were monitored daily. Vase life was determined from the time flowers were placed in vases until flowers lost turgidity and had no value for the consumer. For lilies, vase life was terminated when the last open flower died.

A complete randomized block design was used with a total of four replicates per treatment, with one vase per replicate. Each vase held 10 stems each. Differences between means were determined using Tukey's honestly significant difference multiple comparison test (P<0.05%)

RESULTS

Temperature

Temperature decreased initially to a low of 2.8ºC with vacuum cooling and 3.3ºC with precooling (Fig. 1). Cooling occurred more rapidly with vacuum cooling and temperatures remained lower during most of the transit time in vacuum cooled boxes compared to precooled boxes. Temperatures increased in both treatments during the shipping period. Initially, the vacuum cooled flowers increased to 6.2ºC after 10 hours compared to 5ºC for precooled flowers. After this time, precooled temperatures increased rapidly to 16ºC then remained near 13ºC for 8 hours before increasing to 20ºC after 20 hours. Vacuum cooled flowers remained several degrees cooler for the same 8 hour period, but eventually reached 20ºC after 21 hours.

Vase Life and Quality

Of the four lily cultivars evaluated, only 'Royal Danlarifin' exhibited a statistical difference in vase life, with vacuum cooled flowers lasting 1.2 days longer than precooled flowers (Table 1). In tulips, 'Ille de France' lasted 1 day longer when vacuum cooled and 'Don Quichotte' lasted 1 day longer when precooled, while no differences were found in the other tulip varieties (Table 2). No differences in vase life were observed between the cooling methods on hyacinth, freesia or iris (Table 3). There were no differences observed in other quality parameters such as flower color, leaf yellowing, stem strength or disease. Similar results were obtained in two additional shipments where no major increase in vase life or quality occurred between the two cooling methods.

DISCUSSION

No major differences in vase life or quality were found between the two cooling techniques. Although temperatures remained lower in the vacuum cooled boxes, the results do not demonstrate a substantial value to vacuum cooling since vase life was not affected. Lack of proper temperature control during shipping may have negated any benefit to vacuum cooling, while maintaining low temperatures during transit may have showed a benefit. Other studies have shown only a 1.8 day increase in vase life of cut lilies when vacuum cooled and then stored for 24 h at 3.5°C compared to non-stored flowers (Brosnan and Sun, 2001), while no differences in vase life were found in cut daffodils when stored for 7 days at 2ºC compared to non-stored flowers at 20ºC after vacuum cooling (Sun and Brosnan, 1999).

Vacuum cooling did not affect vase life of lilies unless flowers were sprayed with water prior to cooling, which then increased vase life 1.5 days (Brosnan and Sun, 2001). In daffodils, vase life increased 1 and 2 days when vacuum cooled on non-stored and stored flowers, respectively (Sun and Brosnan, 1999). In their studies, as in the current study, vase life was increased a maximum of 1 to 2 days. Is an increase of one day sufficient to convince the industry to use vacuum cooling at a costs of $0.50/box of flowers, especially when the results are extremely varied with flower type and cultivar?

How can we make a difference in shipping and handling? We must assure that postharvest results concentrate on consumer vase life, not on a single event during the course of postharvest handling. For instance, it is easy to suggest that the rapid drop of temperature from vacuum cooling will result in extended vase life. No study has demonstrated consistent increases in vase life with vacuum cooling even though the temperature graphs demonstrate a rapid and effective cooling process. Continued work is needed to test the benefits of vacuum cooling since this and other studies have been limited in scope. The value of any postharvest procedure or practice must rest with consistent flower longevity and quality, not in the absolute statistical differences obtained between treatments. If postharvest results are to be accepted by the industry, it seems that only those procedures that result in at least a 2-3 day increase or more in vase life or significant changes in flower quality should be recommended to the industry.

Other examples can be found in the industry where products or materials are developed and marketed without a clear value to the vase life or quality of flowers. Considerable discussion has taken place in the last decade about the value of cutting flowers underwater. Results demonstrate that cutting roses dry provides results equal to cutting underwater (Leonard et al., 2001). In fact, we have found that cutting underwater in dirty water results in reduced longevity (unpublished data). So, it is much more cost effective for the industry to cut dry. Even with these results, we find commercial solutions to control microbial activity in underwater cutters but which appear to provide no increase in flower longevity. Do products that do not increase longevity or quality make the industry skeptical of using good postharvest practices? They possibly do. Research scientists, with the industry, must develop and use practices that result in improved flower longevity not the development of materials that do not result in significant value to the customer. In order to make a difference, the following steps are suggested:

- Be specific about products and procedures that really work
- Base conclusions on longevity and quality not on one event in care and handling
- Seek more than statistical differences – aim for 3, 4 and 5 day increases in longevity
- Observe quality as well as longevity differences
- Work with the industry to evaluate new products before commercialization

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Tables

Table 1. The effect of cooling method on vase life of cut lilies.

Variety	Cooling method	Vase life (days)
Stargazer	Precool	9.9a
	Vacuum cool	10.1a
Kyoto	Precool	10.1a
	Vacuum cool	10.5a
Royal Danlarifin	Precool	9.8a
	Vacuum cool	11.0b
Prato	Precool	9.0a
	Vacuum cool	9.2a

[1] Means with different letters within each variety are significantly different at P≤0.05.

Table 2. The effect of cooling method on vase life and quality of cut tulips.

Variety	Cooling method	Flower open Rate[1]	Stem bend rate[2]	Vase life (days)
Ille de France	Precool	2.7a	2.4a	8.3a
	Vacuum cool	3.4b	1.9b	9.1b
Don Quichotte	Precool	4.0a	3.7a	10.6a
	Vacuum cool	4.0a	3.5a	9.9b
Negritta	Precool	3.4a	2.7a	9.7a
	Vacuum cool	3.7b	2.6a	9.5a

[1] Flower open rate:1=tight to 4=fully open.
[2] Stem bend rate: 1=upright; 2=slight bend; 3=fair bend; 4=severe bending.
[3] Means with different letters within each variety are significantly different at P≤0.05.

Table 3. The effect of cooling method on vase life of cut hyacinth, freesia and iris.

Crop	Variety	Cooling method	Vase life (days)
hyacinth	Blue Giant	Precool	6.4a
		Vacuum cool	6.9a
freesia	White Su	Precool	11.4a
		Vacuum cool	11.4a
iris		Precool	6.3a
		Vacuum cool	6.5a

[1] Means with different letters within each variety are significantly different at P≤0.05.

Figure

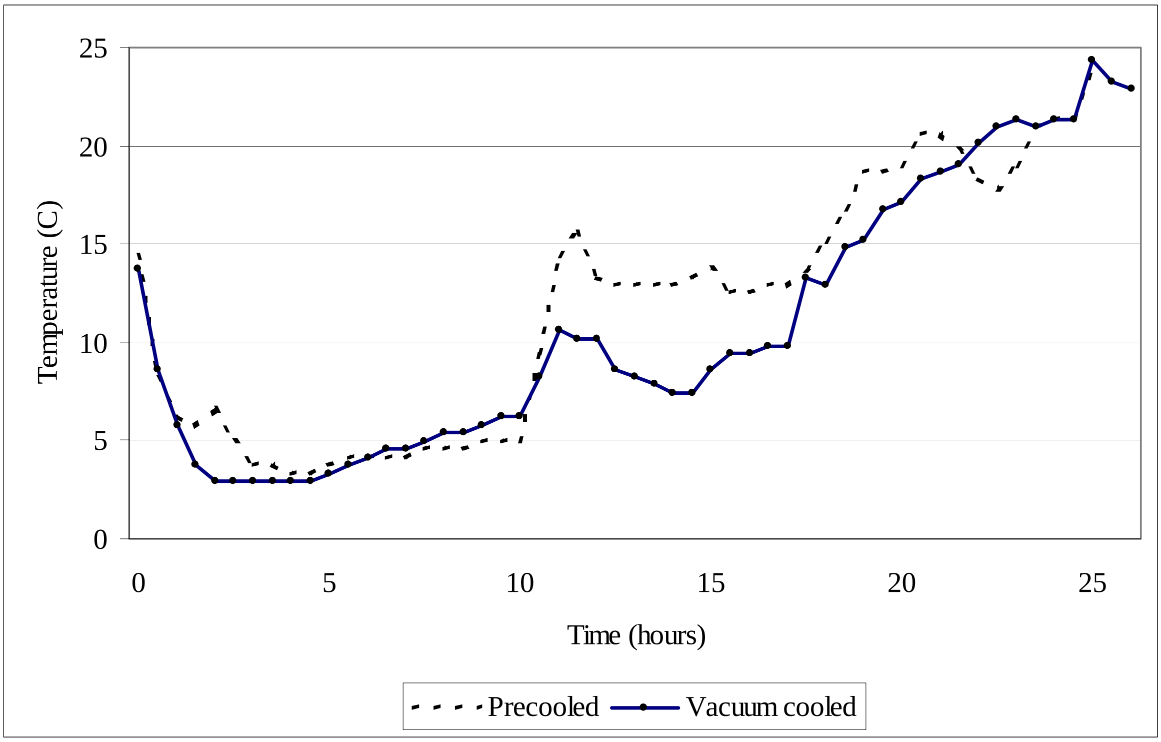

Fig. 1. Comparison of temperatures of precooled and vacuum cooled boxes during cooling treatment and subsequent transport.