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Special Research Report Postproduction # 465: Extended Storage of Cut Flowers Using Subzero Temperature

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BACKGROUND

Cold storage of cut flowers is often a necessity. On most farms it is impossible to harvest enough flowers to satisfy the immediate needs of all customers and markets. Storing cut flowers at cold temperatures of 35-39°F (2-4°C) reduces respiration and transpiration, allowing them to remain fresh and have a longer vase. The duration that flowers can be stored varies with the species from a few days to several weeks. The majority, however, can only be stored for a few days to a week before vase life is reduced.

However, many times it would be greatly advantageous for flowers to be stored longer than a few days. If cut flower growers could hold cut flowers for an extended time, product could be more easily stocked for holidays, markets, and events. In addition, growers would be able to manage excessive production that can occur if warm temperatures speed up crop schedules.

Subzero storage may be useful in extending the storage duration without sacrificing vase life. Earlier work at NC State showed that tulips could be held at 31°F (-0.6°C) for 9 weeks with no loss of vase life and peonies had improved flower opening and quality after being held at 31°F (-0.6°C) for 16 weeks compared to 33°F (0.6°C).

Our objective was to develop a practical long-term storage process for selected cut flower species using subzero temperatures.

MATERIALS & METHODS

Experiment 1 evaluated differences in viability, vase life, and quality of 17 commercially-important cut flower species: alstroemeria, anemone, campanula, carnation, chrysanthemum, delphinium, freesia, gerbera, gypsophila, larkspur, lily, lisianthus, ranunculus, rose, stock, sunflower, and tuberose when stored dry at either 31°F (-0.6) or 39°F (4 °C) for durations of 4, 8, and 12 weeks.

Experiment 2 examined using a pre-storage pulsing treatment of water, hydrating solution, or holding solution containing carbohydrates for 8 hours prior to extended storage for carnation, chrysanthemum, delphinium, lily, and rose stems.

Experiment 3 evaluated carnation, lily, and rose stems with and without a pre-storage acclimation period at 39°F (4 °C) for either 24 hours or 1 week prior to extended storage durations of 4, 6, or 8 weeks at either 31°F (-0.6) or 39°F (4 °C).

RESULTS

In experiment 1 all species stored at 31°F (-0.6°C) were comparable to or had longer vase life than stems stored at 39°F (4 °C) (Table 1, Fig. 1). Tuberose stems were not viable after holding for any storage duration or temperature.

Table 1. Post-storage evaluation of 17 cut flower species to determine the effects of long-term storage duration and temperature on vase life (including controls) and viability following durations of 4, 8, or 12 weeks at either 31 or 39 °F (-0.6 or 4 °C) (Expt. 1). Control stems were not stored and placed directly into vases for evaluation. nv= stems were not viable post-storage.

	Vase life (days)						
	Storage temperature						
	Control	31°F (-0.6°C)			39°F (4°C)		
	Storage duration (weeks)						
Species	0	4	8	12	4	8	12
Alstroemeria	16.9	14.7	8.5	nv	12.3	4.0	nv
Anemone	3.9	3.5	3.3	nv	nv	nv	nv
Campanula	12.6	11.0	11.9	nv	10.8	nv	nv
Carnation	12.2	7.4	4.0	4.7	7.0	4.3	8.8
Chrysanthemum	11.9	7.0	3.4	2.0	2.8	nv	nv
Delphinium	13.7	3.2	nv	nv	4.0	nv	nv
Freesia	8.1	2.8	nv	nv	3.1	nv	nv
Gerbera	11.5	2.0	nv	nv	3.4	nv	nv
Gypsophila	15.8	5.0	nv	nv	8.9	nv	nv
Larkspur	8.7	6.7	5.0	nv	3.6	nv	nv
Lily	8.1	4.9	4.1	3.5	2.4	nv	nv

Lisianthus	7.0	2.3	nv	nv	2.4	nv	nv
Ranunculus	8.3	6.6	3.3	2.3	4.8	nv	nv
Rose	7.1	6.9	6.0	5.0	3.4	4.3	3.0
Stock	6.0	3.1	nv	nv	nv	nv	nv
Sunflower	6.7	2.0	nv	nv	nv	nv	nv
Tuberose	7.2	nv	nv	nv	nv	nv	nv

Fig. 2. Average vase life visual representation of stored rose 'Freedom Red' flowers compared to non-stored control flowers after 4- and 8-week storage durations held at -0.6 or 4 °C (31 or 39 °F) (Expt. 1).

In experiment 2, stems of carnation benefitted from pulsing with a hydrating solution and maintained similar vase life to non-stored control stems when stored for 4 weeks at subzero temperature. Conversely, rose stems only maintained similar vase life to non-stored control stems when held at 39°F (4 °C) for all pulsing solutions. Lily and chrysanthemum stems had a decline in vase life for all pulsing solutions, but only remained viable after 8 weeks storage when held at subzero temperature. Additionally, stored chrysanthemum and lily stems maintained longer vase life when stored at 31°F (-0.6°C) than when held at 39°F (4 °C) after 4- and 8-weeks storage, respectively, for all pulsing solutions. Delphinium were not viable after any storage duration.

In experiment 3, holding stems at 39°F (4 °C) for 1 week prior to extended storage reduced vase life of all species. Rose stems remained viable after 8 weeks of extended storage when held at 31°F (-0.6°C), but only when no pre-storage holding was used. Lily and rose stems were not viable beyond 4-week storage durations when held at 39°F (4 °C), but remained viable with no pre-storage holding period after 8 weeks at 31°F (-0.6°C). Carnation stems maintained longer vase life irrespective of a pre-storage holding period when stored at 31°F (-0.6°C).

CONCLUSIONS

Almost all species of cut flowers tested remained viable for similar or longer durations at subzero (31°F, -0.6°C) temperature and in many instances, had longer vase life than when stored at the industry standard of 39°F (4°C). When stored at subzero temperature for extended periods, many species did not lose as much water and had less disease than when held at 39°F (4°C). The length of storage freshly cut flowers can withstand without loss in viability or quality varied among species and cultivar. Rose and carnation stems were the most tolerant of extended storage durations, up to 12 weeks, while tuberose was not tolerant of any storage duration regardless of holding temperature.

Pre-pulsing stems with hydrating or holding solution prior to extended storage at subzero temperature did not prove to be substantially beneficial for maintaining longevity or fresh weight. However, when pulsed with hydrating solution and stored at 39°F (4 °C) rose stems had increased rates of viability, while chrysanthemum stems generally maintained longer vase life after storage at subzero temperature. Cut carnation benefited more from a holding solution with carbohydrate and maintained similar vase life to non-stored control stems and improved turgidity when held at subzero temperature. Holding cut stems at 39°F (4 °C) for 24 hours prior to extended subzero storage did not consistently improve vase life. Extending the holding period to 1 week was detrimental to viability, fresh weight, and ability of flowers to fully expand.

Further research into more cultivars for these species would be beneficial to determine if these results are cultivar specific. However, it may be more cost-effective to store stems dry directly from harvest with an acclimation period.

IMPACT OF RESEARCH TO THE INDUSTRY

Through this research we substantiate that many species of cut flower may be held at subzero 31°F (-0.6°C) temperature with improved or comparable vase life to the industry standard of 39°F (4 °C). This work provides producers with another tool to allow them to match product availability to demand for holidays, markets, and events and hold flowers if unexpectedly warm temperatures speed up production, forcing early harvests.

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