Aspects of Postharvest Management of Selected Field-Grown Cut Flowers

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Abstract

Downward pressure of prices, rising cut-flower-imports, environmental consciousness and constraints are some of the leading factors to enhance and popularize extensive and organic flower production. Austrian growers question whether to intensify high input protected cultivation systems and/or to shift to low input extensive field growing systems. In general grading, sorting, cooling and application of floral preservatives are the main post-harvest management techniques that can be applied throughout the post-harvest chain. Usually the produce is commercialized on the central Viennese Green Market, on regional markets or at direct sales centers. Post harvest treatments suitable for organic and conventional integrated field-grown specialty cut flowers were tested to maintain product quality passing the post harvest-chains.

INTRODUCTION

Downward pressure of prices of several well-established cut flowers (e.g. roses, carnations, tulips), still rising cut-flower imports, environmental consciousness and constraints are some of the main factors to enhance and popularize again extensive growing of specialty cut flowers. In addition organic growers, certified by guidelines of European Communities or the more restrictive regulations of specific associations emerged during the last years - members of the main Austrian Organic Growers’ Associations “ERNTE Verband“) are expected to gain additional importance on the ornamental-markets during the next years by increased introduction of organic cut-flowers. The average, usually small scale family driven nursery has to face the question whether to intensify high input protected cultivation systems or to shift to lower input extensive field growing systems. For decennia, Austrian growers have been marketing directly via Green Markets and/or to retailers. Short distribution distances, storage and transportation periods are characteristic for regional marketing systems. This results in delivering “fresh and high quality” cut flowers to consumers without need of intensive post-harvest care of produce (e.g. long term storage, controlled atmosphere storage). In general, sorting, grading, in some cases leaf removal and cooling are applied as post harvest management techniques. Use of floral preservatives is gaining acceptance and application throughout the post harvest chain. Yet, there is a high potential of optimization. For conclusive concepts of “Quality” and “Quality Management” are still perceived as new emerging prescriptions for growers in Austria - very rarely as a chance and challenge to improve and promote production and marketing. All in all “Quality Systems” are just slowly establishing in Austrian floriculture and still may be completed by additional concepts like “Ethic Quality” (social value and responsibility) and “Ecological Quality” (e.g. consumption of natural resources, CO₂-balancing,…). These circumstances meet a fast growing consumers’ demand for some specialty cut flowers, e.g. sunflowers, asters, dahlias. Still there is lack of information on some of above-mentioned aspects. Therefore, several experiments were conducted to collect information on potentials of extensive and organic growing systems, taking care of reliability in producing marketable quality of cut flowers, and introduce and/or improve
knowledge and consciousness of techniques in maintaining quality and quality features during the post-harvest chain up to the consumers’ stage.

MATERIAL AND METHODS

We tested several methods of growing and post-harvest handling that would fit into Austrian direct distribution systems and could help to maintain product quality and improve quality of handling at growers’ sites and procedures. We tried to correlate physiological parameters with so called parameters of quality (vase life, appearance). This would provide data for monitoring and modeling in future. One of the main scopes was to improve the data basis for specialty cut flowers compared to provided one in literature (Nowak and Rudnicki, 1990; Salunkhe et al., 1989). Besides, we tried to find recommendations that fit to regional eastern Austrian growing circumstances.

At the Institute’s Horticultural Research Station (Vienna; 180 m, long term average precipitation 512 mm, long term average temperature 9.8 °C, degraded Czernosem, sandy loam to loamy sands), cultivars of selected annual species were cultivated according to commercial growers’ horticultural practice: Helianthus annuus “Floristan” and “Holiday” were sown directly, Delphinium consolida “Prachtmischung”, Ammobium alata “Bikini” were sown and grown under protected culture and planted in the field (begin of May).

Rooted plantlets with four leaves from Dahlia variabilis “Primaner” and “Red Cap” were derived from cuttings and planted in intercropping systems in the field (intercropping partners: Zea mays or winter rye (Secale cereale) or Scabiosa atropurpurea) in four replications per intercropping system. Dahlia plants then were trained for harvesting cut flowers. Intercropping systems of D. variabilis followed different aspects of strategies: Zea mays (ornamental corn) for protecting Dahlia from high temperature and sun irradiation (shadowing); Scabiosa atropurpurea as a second crop as well to use growing area more intensive as cover soil surface and Secale cereale for covering of soil surface. The standard for comparison was a single cropping system of Dahlia variabilis.

H. annuus “Holiday” was grown in a trial comparing (1) conventional integrated production (according to Austrian regulations for Integrated Production), (2) several organic trials (according to regulations of Austrian organic growers association “ERNTE”; different strategies of fertilizing: cattle manure, horn meal, organic compost) and (3) a no input system without chemical plant-protection and fertilizing. There were 4 replications each in a randomized arrangement.

Criteria of Selecting the Cut Flower Species

• Underutilized floral crops
• Annual species
• Suited for dry warm site-conditions (site-adapted sustainable production)
• Potential for organic and extensive growers
• Emphasis on regional marketing; no or low trans-regional economic competition

Treatment of Material

• Harvest and transport early morning
• Practices such as sorting, watering, pre-cool in a shady cool environment
• Transport to the University (ca. 1 h)
• Cold storage in a cool storage room (4 °C, Dahlia cut stems stored wet in water; or stored dry, both with light wrapped by newspaper)
• Application of commercial floral preservatives or disinfectants.
• Stem-end treatments (hot water dipping at 60°C 30 seconds or ultrasonic treatments in an ultrasonic water-bath at room temperature for 30 seconds)

Methods

To study the effects of suitable post-harvest management strategies (cool storage,
application of floral preservatives, stem-end treatments), cut flowers were harvested in the 
early morning, watered within 30 minutes and transported; by car to the Institute the 
following hours (dry transport). Except for stem-end treatments of sunflowers the cut 
stems were re-cut in air and prepared for treatments: a) stem-end treatment of sunflowers 
(hot water, ultrasonic bath), b) impact of commercial preservatives on vase life, c) effect 
of cold storage duration on *Dahlia* (4 °C, 96-98 % RH).

Effects of treatments were evaluated by measuring physiological parameters and 
effects on vase life of cut flowers. Vase life studies usually were arranged in three 
replicates and three specimens per replicate. Vase life studies were performed in the 
research laboratory at the institute following recommendations by Reid and Kofranek 
(1980). Selected floral preservatives marketed by the Austrian Growers Cooperative were 
used for experiments: ‘Chrysal clear’, ‘Flora 2000’, ‘Biovin’, ‘Oasis flower fresh’ and the 
Austrian product ‘Biovin’. The latter usually is used as a liquid fertilizer but 
recommended as a vase water additive too by the producing company. Standards were 
Viennese tap water and/or Standard Vase Solution (SVS) as introduced by van Meeteren 
et al. (2000). For some species, copper-sulphate and hydroxyquinolinesulphate (8-HQS) 
solutions were used. In some cases, adding sucrose was tested additionally (Brecheisen et 
al, 1995). All solutions were prepared using distilled water from reverse osmosis.

Emphasis of performed methods was on using nondestructive methods (Abbott 1999; 
Chen 1999). Parameters measured:

- Fresh weight & dry matter weight (including ash; drying procedure: 105 °C 2h, 85 °C 
  3 days in a Herret aerated drying oven). (Sartorius, Aut)
- Vase life (d, two evaluations per day)
- Brix value of petal press sap (Atago, Jp)
- Petal & leaf colour (CIE L*a*b*, Colorimeter CR 200, MINOLTA, Jp). Data 
  submitted elsewhere, not shown here.
- Chlorophyll fluorescence \((F_o, F_v, F_m\), quenching coefficients; Mini PAM, Walz, D) 
  at ambient conditions (not dark adapted). Data submitted elsewhere, not shown here.

Measurement of physiological parameters was used to estimate basic quality 
features like appearance, vase life performance, freshness and so on. Data were analyzed 
using MSE Excel 97, Statgraphics 2.0 or SPSS 11.0.

**RESULTS AND DISCUSSION**

Vase life of specialty cut flowers, covering all investigated species and cultivars, 
in most cases was significantly affected by treatments with floral preservatives. 
Commercial floral preservatives in general promoted vase life duration – the effect 
however was sometimes of lesser extent than non-commercial disinfectants (copper- 
sulphate, 8-HQS) or even the standard (Standard Vase Solution; van Meeteren et al., 
2000). These effects varied in extent and no dependency on pre- or post harvest trial 
factors could be determined. We assume that pre harvest conditions may have a stronger 
influence on post harvest performance than expected or ripening stage was not as 
common as we thought although it was always the same person harvesting and preparing 
for tests. For the moment, we conclude that floral preservatives should be used. Any of 
them supported post harvest performance, but there was non we could claim to be “the 
best”. We still have no certainty and reliability about promoting effects of floral 
preservatives on vase life and other quality parameters. At least, one can expect that floral 
preservatives provide a lower risk during post-harvest chain and support satisfaction of 
consumers’ demand. We still need more information to use the effect (positive or 
detrimental) of different preservatives used throughout the post-harvest chain to have 
reliable information of their contribution to post harvest performance.

Biovin, an extract from composted grape-residuals from wine production, could 
not be recommended as a floral preservative in all cases as is shown here for sunflower 
and larkspur (annual) cut stems (Fig. 3, 4 & 7). Other experiments exhibited somewhat 
similar results – sometimes strong effects, sometimes none (data not shown here). At least 
in no case we found detrimental effects.
Dahlias can be stored at 4 °C without quality losses up to 48 hours (storage is possible up to four to five days without rapid decline of vase life; data not shown). Dry storage turned out to be the better technique when compared to wet storage. But, not to see in the graphic, a strong re-cut is needed. Chrysal promoted vase-life in the case of Dahlia excellent. Intercropping systems did not affect vase-life of cut stems compared to single cropping (Fig. 1 & 2).

Stem-end treatments of sunflower were effective to overcome vascular blockage and were necessary to result in a satisfying vase life up to 7 (8) days. Ultrasonic treatment seems to be less harmful than hot water treatments, indicated by slightly better vase-life performance. Growing systems, summarized as pre harvest conditions, have shown impact on post harvest performance, evaluated as vase life. Yet the effects are not clear and stringent. The application of commercial preservatives added no clear additional duration of vase-life as positive effect, yet not always significant. Addition of sucrose (2%) to vase solution enriched content of organic compounds in petal press sap prolonged in most cases vase life too, but not to a satisfying extent (exception was Chrysal) (Fig. 3 and 4). A supply with sucrose together with a preservative is not a guarantee for supporting vase life – looking at the case of Biovin, showing high Brix values in the petals’ press sap but exhibiting a poor vase life of 4 to 5 days (Fig. 3 and 4).

Organic growing systems, compared to integrated and no-input (except of irrigation) systems could not exhibit significant differences. A slight increase in vase-life for organic grown sunflowers may be detected but was not possible to prove (Fig. 5 and 6). At least – organic growing systems are resulting in the same “post harvest quality” as conventional growing. This is the good message. A real surprise were the the cut sunflowers derived from “no input trial” (that is about 6 years without fertilization!), for sunflower is known for high demand in mineral nutrition. Our expectation to have real bad “quality” out of this trial turned out to be wrong. At the moment we cannot explain.

All in all - after having been conducting vase-life experiments for several years and having been dealing with quality and horticultural fresh produce - we are back at the beginning – what is a holistic approach to quality? It is not product quality for itself – and besides visual quality it is not reliable to measure (in case of cut flowers). So we start to think about integrating (maybe) more important features to claim as parameters of quality: sustainability-, ecological- and social-based parameters. This may be a more promising way to quality – than physiological effects of post-harvest compounds.

Literature Cited
Fig. 1. Postharvest treatments and intercropping system affecting postharvest-life of *Dahlia variabilis* "Red Cap".

Fig. 2. Postharvest treatments and intercropping system affecting postharvest-life of *Dahlia variabilis* "Primaner".
Fig. 3. Mean Vase-life of *Helianthus annuus* "Holiday" in different vase solutions.

Fig. 4. Mean Brix of petals of *Helianthus annuus* "Holiday" in different vase solutions.
Fig. 5. Vase-life of *Helianthus annuus* - effects of growing-system, stem end treatment in commercial fresh flower food "Flora 2000".

Fig. 6. Vase-life of *Helianthus annuus* - effects of growing-system, stem end treatment in Viennese tap water.
Fig. 7. Vase-life of field grown *Delphinium ajacis* cut-stems in different floral preservatives, tap water and Standard Vase Solution (SVS).