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ASPECTS REGARDING THE ANATOMY OF THE STEM AND LIFETIME AS CUT FLOWERS OF SOME DAHLIAS CULTIVARS

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Abstract

Plants of the Dahlia genus are particularly valued for their wide variety of shapes and colors both as cultivated plants and as cut flowers thus increasing the interest for the introduction in the culture of cultivars with great decorative value and great resistance as cut flowers. The work presents anatomical aspects, but also particularities regarding the life span of cut flowers in preservation solutions for the cultivars 'Topmix Red', 'Hy Pimento', 'Babylon Red', 'Marble Ball' and 'Thomas Edison'. The objective of this study was to analyze dahlia varieties both from the anatomical point of view and the preservation of cut flowers in vases using different preservation solutions to establish a correlation between the diameter of xylem vessels and cut flower life. The diameter of the xylem vessels does not seem to influence the life span of the cut flowers, regardless of the solution used in the conditions of this experiment. The Quick dip and eZDose conservation solution increased the lifespan of the varieties studied compared to the other conservation solutions used.

Key words: *cross-sections, cut flowers, dahlia, flower longevity, xylem.*

INTRODUCTION

Dahlias are native to Mexico. Here, the first dahlia flowers appeared, the first species that constituted inexhaustible sources for the emergence of new varieties, some of which are more interesting due to the flowers' composition, size, or color (Șelaru & Mucescu, 1976). Dahlia has a fistulous stem, 30-200 cm high. The main stems form several branches that give an appearance garnished with shoots, leaves, and flowers (Pârvu, 2003). Dahlias have leaves colored in intense green, bright, and pinnately lobed, with sharp and dented lobes on the edge (Toma, 2009). Dahlia flowers are grouped in calathides (Berar et al., 2006), and they bloom profusely from July to late autumn (Băla, 2007). The role of the flowers is particularly important in human life, fulfilling several essential functions: aesthetic, social, sanitary, and socio-economic (Toma, 2003). The richness, splendor, and beauty of the landscapes that can be created in parks and gardens by cultivating perennial flowers, constitute an enchantment (Rovența, 1968). Being used for aesthetic, artistic (sources of inspiration for painters, poets, and composers), and sanitary purposes (they maintain the balance in the composition of the air, retain dust from the atmosphere, and maintain a higher atmospheric humidity), flowers definitely influence the physical and mental state of man. Dahlia is a flower that can be grown in any kind of garden, alone or combined with other annuals or perennials. The way Dahlia is used to decorating the private garden depends on the available space and the personal ideas and wishes of each dahlia lover, but to make something interesting and special it is advisable for the private grower to ask for the advice of a specialist or visit different public gardens where inspiration can be found (Cantor et al., 2012). The aesthetic importance of flowering plants grows and becomes increasingly complex under the conditions of the contemporary era (Șelaru, 2002). This cut flower has very particular characteristics, becoming one of the most beautiful flowers abroad; furthermore, it is the single plant that has the largest number of cultivars of all plant species and more than 50,000 have been registered with the Royal Horticultural Society of England (Bye & Linares, 2008).

Cut flowers account for about half of the market for horticultural products, with

developed countries consuming more than 90%. Many consuming countries do not have ideal climatic conditions for the production of cut flowers so the flowers grow in protected environments, therefore production prices increase (Ovando et al., 2006). Cut dahlia flowers (Dahlia Cav.) have long been popular with consumers, and their relatively short longevity after harvest means growers and retailers are looking for ways to extend the life of potted flowers (Bergman et al., 2019).
The objective of this study was to analyze dahlia varieties both from the anatomical point of view and the preservation of cut flowers in vases using different preservation solutions to establish a correlation between the diameter of xylem vessels and cut flower life using different preservation solutions.

MATERIALS AND METHODS

The biological material was represented by dahlia plants grown in the "I. Todor" Botanical Garden of the University of Agronomic Sciences and Veterinary Medicine Bucharest. The cultivars studied were 'Topmix Red', 'Hy Pimento', 'Babylon Red', 'Marble Ball' and 'Thomas Edison' (Figure 1).

Figure 1. Dahlia culture in the "I. Todor" Botanical Garden of the University of Agronomic Sciences and Veterinary Medicine Bucharest
(Source: original)

The studies were carried out during the year 2022. Anatomical observations and measurements were made on cross-sections from the apical and basal areas of the floral stem. The sections were clarified with chloral hydrate and stained with carmine-alum and iodine green, according to the classical method (Morlova et al., 1966). The following anatomical needle traits were measured: E = Epidermis; C = Cuticle; H = Hypodermis; M = Mesophyll; Rc = Resin canals; En = Endodermis; Tt = Transfusion tissue; Vb = Vascular bundles; X = Xylem; Ph = Phloem. Observations, measurements, and photographs were taken with the LEICA DM 1000 LED optical microscope, LEICA DFC 295 video camera, and LEICA S 8 APO stereomicroscope, using 4x, 10x lenses, existing in the endowment of the Research Center for Studies of Food Quality and Agricultural Products (USAMV of Bucharest).
As far as highlighting the lifespan of dahlia cut flowers is concerned, tap water was used for the control sample, and the preservation solutions taken in the research were represented by Quick Dip and eZDose, Floralife Express No Cut, and Finishing Touch (Figure 3).
All stems from the three sources were kept in water from the time of cutting until arrival at the laboratory (30 minutes) and 3 repetitions were performed within the experiment. Stems were cut to 30 cm and all leaves were removed before being placed in the treatments used. Harvesting took place in the morning, the inflorescences were fully opened. All solutions were made with tap water and the stems were placed in 250 ml vessels and the storage temperature was 22°C. The shelf life of the cut flower in the pot is over when half of the flower has faded and wilted (Figure 2).

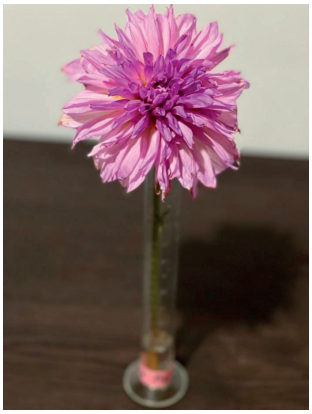


Figure 2. Wilted and discolored inflorescence (Dahlia 'Thomas Edison') (Source: original)

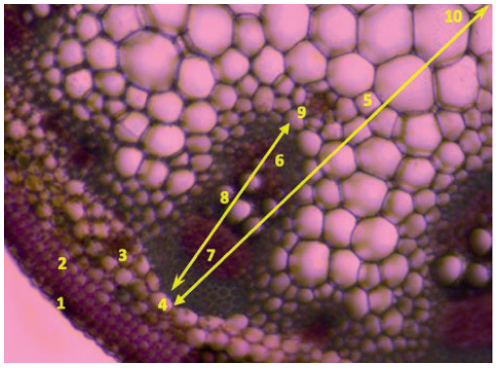
Figure 3. Studied cultivars: 'Topmix Red', 'Hy Pimento', 'Babylon Red', 'Marble Ball' and 'Thomas Edison' (Source: original)

RESULTS AND DISCUSSIONS

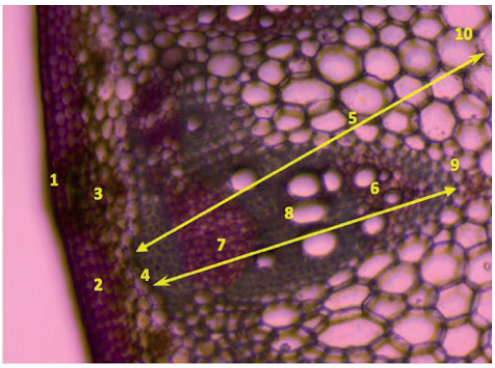
Anatomical observation

The epidermis has a single row of cells, tangentially elongated; the outer cell walls are covered by a thin layer of cuticle. Collenchyma has four layers of an angular type beneath the epidermis representing the first cortex zone (or hypodermis). Chlorenchyma: the second cortex zone is a parenchyma with chloroplasts, consisting of 2-3 cell layers. Endodermis has the inner zone of the cortex is visible, and it is composed of a single layer of tangentially elongated cells. In the Central Cylinder, vascular bundles are arranged on a single circle, larger bundles alternating with smaller ones. A vascular bundle is of collateral type, edged by a sclerenchyma tissue; the vascular cambium has finished the annual cell production, and there are no more visible traces of cambium activity between the phloem and xylem zone. At the end of some vascular bundles, secretory channels can be seen towards the pith area. They are surrounded by collector cells. The pith is represented by a parenchyma with lacunar collenchyma from place to place (Figure 4).

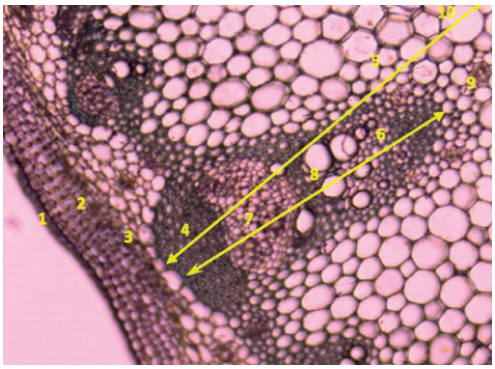
'Marble Ball'



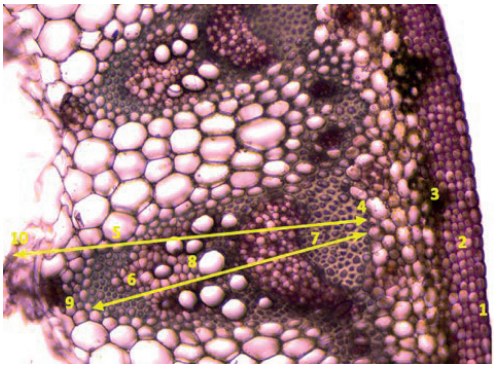
'Hy Pimento'



'Topmix Red'



'Babylon Red'



'Thomas Edison'

Figure 4. Cross section through the stem from 5 cultivars of Dahlia: 'Marble Ball', 'Hy Pimento', 'Topmix Red', 'Babylon Red' and 'Thomas Edison'
Legend: epidermis (1), collenchyma (2), chlorenchyma (3), endodermis (4), central cylinder (5), vascular bundle (6), phloem (7), xylem (8), secretory channels (9), the pith (10)
(Source: original)

Table 1. Diameter of xylem vessels and vase life to Dahlia

Cultivar	Fresh-keeping agent	Vase life (days)	Diameter of xylem vessels (µm)
'Topmix Red'	Tap water	3.50	23.08
	Quick dip + eZDose	5.00	23.08
	Floralife Express No Cut	4.33	23.08
	Finishing Touch	4.00	23.08
'Hy Pimento'	Tap water	5.50	23.46
	Quick dip + eZDose	6.50	23.46
	Floralife Express No Cut	6.33	23.46
	Finishing Touch	5.33	23.46
'Babylon Red'	Tap water	5.00	23.96
	Quick dip + eZDose	6.50	23.96
	Floralife Express No Cut	5.99	23.96
	Finishing Touch	5.50	23.96
'Marble Ball'	Tap water	3.50	21.99
	Quick dip + eZDose	6.33	21.99
	Floralife Express No Cut	5.66	21.99
	Finishing Touch	5.00	21.99
'Thomas Edison'	Tap water	4.67	24.61
	Quick dip + eZDose	5.50	24.61
	Floralife Express No Cut	4.99	24.61
	Finishing Touch	4.83	24.61

A very weak correlation between the diameter of xylem vessels (µm) and vase life (days) was recorded ($R^2 = 0.043$, $y = -0.1311 x + 24.812$, where y = diameter of xylem vessels and x = vase life). The diameter of the xylem vessels does not seem to influence the life span of the cut flowers, regardless of the solution used in the conditions of this experiment (Table 1).

Observations on the lifespan of dahlia cut flowers

Analyzing Table 2, it is observed that there are statistically guaranteed differences between the 4 conservation solutions on the 5 Dahlia cultivars. The shortest storage period of 3.5 days was recorded for the cultivars 'Topmix Red' and 'Marble Ball' in the tap water solution (control sample), and the longest storage period of 6.5 days was recorded for the cultivars 'Hy

Pimento' and 'Babylon Red' in the Quick dip and eZDose solution.

Variants V_6 ('Hy Pimento'/Quick dip and eZDose) and V_{10} ('Babylon Red'/Quick dip and eZDose) with a count of 6.5 days in the preservation solution are distinctly statistically significant compared to the other variants. Variants $_7$ ('Hy Pimento'/Floralife Express No Cut) and V_{14} ('Marble Ball'/Quick dip and eZDose) with a number of 6.33 days are statistically significant. The lowest value of 3.50 days specific to variants V_1 ('Topmix Red'/Tap water) and V_{13} ('Marble Ball'/Tap water) makes these variants highly significantly negative compared to the other 18 variants. Variant V_4 ('Topmix Red'/Finishing Touch) is statistically significantly negative, and the variants V_2, V_3, V_5, V_8, V_9, V_{11}, V_{12}, V_{15}, V_{16}, V_{17}, V_{18}, V_{19}, V_{20} show insignificant differences.

Tabel 2. The influence of conservation solution on the taking of the decorative value of Dahlia flowers

Var. no.	Cultivar	Fresh-keeping agent	Vase life (days)	Relative vase life (%)	+/- days	Signification of the difference
1	'Topmix Red'	Tap water	3.50	67.34	-1.70	000
2		Quick dip + eZDose	5.00	96.20	-0.20	-
3		Floralife Express No Cut	4.33	83.25	-0.87	-
4		Finishing Touch	4.00	76.90	-1.20	0
5	'Hy Pimento'	Tap water	5.50	105.82	0.30	-
6		Quick dip + eZDose	6.50	125.06	1.30	**
7		Floralife Express No Cut	6.33	121.73	1.13	*
8		Finishing Touch	5.33	102.55	0.13	-
9	'Babylon Red'	Tap water	5.00	96.20	-0.20	-
10		Quick dip + eZDose	6.50	125.06	1.30	**
11		Floralife Express No Cut	5.99	115.31	0.80	-
12		Finishing Touch	5.50	105.76	0.30	-
13	'Marble Ball'	Tap water	3.50	67.34	-1.70	000
14		Quick dip + eZDose	6.33	121.85	1.14	*
15		Floralife Express No Cut	5.66	108.90	0.46	-
16		Finishing Touch	5.00	96.14	-0.20	-
17	'Thomas Edison'	Tap water	4.67	89.79	-0.53	-
18		Quick dip + eZDose	5.50	105.82	0.30	-
19		Floralife Express No Cut	4.99	96.07	-0.20	-
20		Finishing Touch	4.83	92.93	-0.37	-
	Average		5.20	100	Martor	

LSD 5% = 0.95
LSD 1% = 1.27
LSD 0.1% = 1.67

Analyzing Figure 5, it can be seen that the lowest values specific to variant V1 ('Topmix Red') make this variant inferior to the other variants. The cultivar 'Hy Pimento' was best preserved in Quick dip and eZDose preservative solutions, followed by Floralife Express No Cut, Finishing Touch, and tap water preservatives, demonstrating that this cultivar was superior to the others in terms of resistance in the dish.

The preservation solution used influences the shelf life of cut flowers according to research by Ciobanu (2017), Dole et al. (2005), Lukaszewska (1986).

Regarding the maintenance of cut flowers, studies have shown that treatment with cytokinin or gibberellic acid can improve post-harvest quality and longevity. It was also shown that maintaining cut dahlia flowers in a solution containing both benzyladenine and gibberellic acid at 10-20 mg L^{-1} improved flower quality after 4 days in the vase and extended shelf life (Bergman et al., 2019).

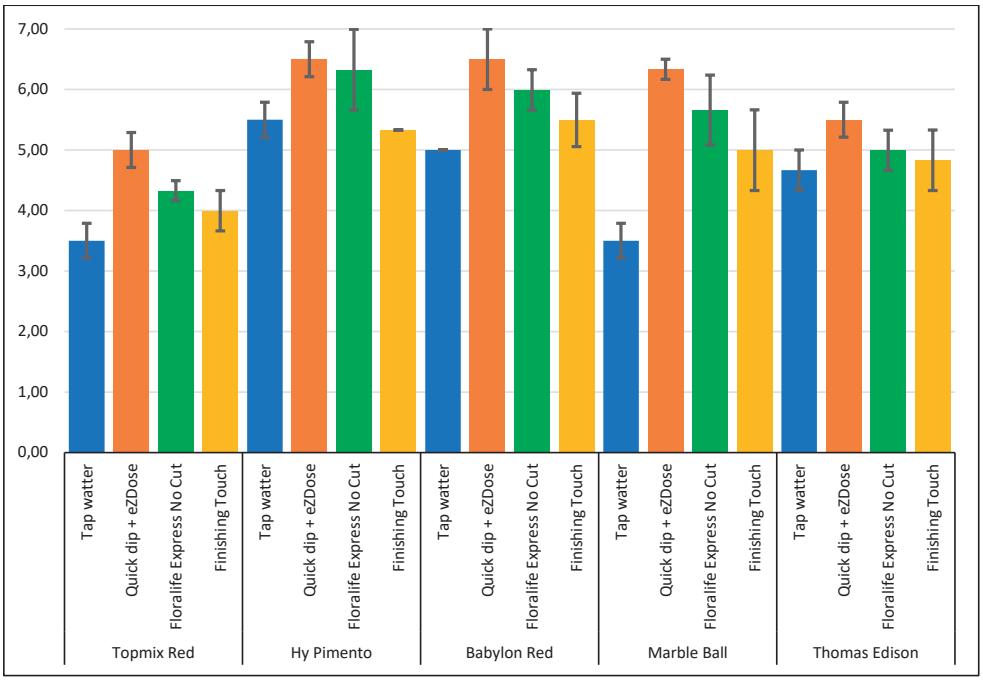


Figure 5. The lifetime (days) of five Dahlia cultivars in conservation solution (Tap water, Quick dip and eZDose, Floralife Express No Cut, Finishing Touch)

Regarding the improvement of the vase life of Dahlia cut flowers, a breeding research program using conventional cross-breeding techniques was carried out. Significant differences were found in terms of flower life in the vase, namely: nine cultivars had a long vase life (e.g. 'Syukuhai', 'Rinka' and 'Micchan'); eight had a normal vase life (e.g. 'Kamakura', 'Agitate' and 'Benifusya'); and seven had a short vase life (e.g. 'Gin-Ei', 'Port Light Pair Beauty' and 'Yumesuiren'). 22 cultivars were used as initial breeding materials, repeatedly crossed, and promising progeny with long vase life were selected for three generations. The results strongly suggest that 'Micchan' has genes related to long flower life in the vase and that the trait is heritable (Onozaki & Azuma, 2019).

The vase life of flowers is one of the most important traits for ornamental plants. The lifespan of cut flowers of dahlia (Dahlia variabilis) is very short, and genetic improvement of this trait is desirable (Onozaki & Azuma, 2019).

Studies by Shimizu-Yumoto and Ichimura K (2013), showed that dahlia flowers are sensitive to ethylene, but ethylene production by floral organs did not increase significantly during flower senescence. Silver thiosulfate complex did not extend the lifespan of cut flowers in the vase, while 1-methylcyclopropene extended the lifespan of the flowers. When 6-benzylaminopurine was applied either on bouquets by dipping or on flowers by spraying, the life of the dahlia was extended. In addition, 6-benzylaminopurine treatment with immersion prolonged the lifespan of the bouquets more than the 1-methylcyclopropene treatment.

CONCLUSIONS

The importance of dahlias is given by the decorative qualities of the inflorescences, being appreciated both as a cut flower and in floral arrangements, both alone and in association with other flowers. They stand out through a very varied range of colors and shapes, thus increasing the interest in the introduction into the culture of cultivars with great decorative value and great resistance as cut flowers.

The 'Topmix Red' cultivar is a dwarf cultivator that fits as a decorative garden plant and is not suitable as a plant in the vase because it has a very small life durate in the vase.

'Hy Pimento' and 'Babylon Red' cultivars have a longer life in the vase and are suitable for decorating the house.

Conservation solutions have extended the life in the vase of 'Hy Pimento' and 'Babylon Red' cultivars (6.5 days/Quick dip and eZDoe solution), followed by the 'Marble Ball' cultivar (6.33 days/Quick dip and eZDoe solution) and 'Thomas Edison' (5.5 days/ Quick dip and eZDoe solution).

The Quick dip and eZDose conservation solution increased the lifespan of the varieties studied compared to the other conservation solutions used.

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MISCELLANEOUS


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