

## PARTIAL RESULTS ON THE LIFETIME OF FLOWERS IN VASES OBTAINED BY USING DIFFERENT SOLUTIONS OF SOME HERBACEOUS PEONY CULTIVARS

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### Abstract

*The present work is of a necessary topicality and is of major importance in that it presents observations and results that contribute to maintaining the flower life in vases for as long as possible, thus helping the herbaceous peony cultivators as cut flowers, flowerings but also people who love this flower for keeping and decorating peony flowers as long as possible. This research study brings to light the results regarding the use of traditional solution recipes in pots water for the longest storage of flowers in pots. The material is represented by cultivars: Festive Maxima, Dorren, Pink Giant, Kansas. In this research, 17 recipe solutions were used to keep flowers in vases. As research methods, biometric measurements, determinations and visual observations were used during the research period. The biometric measurements were made by the following indicators: phenophase in which the buds are; diameter of the buds; diameter of the flower stem; length of flower stems. The visual observations were made by the following indicators: flowering phenophases (semi-open bud, flower opening, total flower opening, flowering completion, petal shaking) and flower vase maintenance (days). Different results were observed regarding the lifetime of the flowers in pots depending on the cultivar used. This resulted in a minimum duration of storage of flowers in pots of 5 days until a maximum duration of storage of flowers in pots of 11 days from the moment of harvesting from the plant.*

**Key words:** cut flowers, peony, solutions, vases.

### INTRODUCTION

This paper is of great importance, being also topical, due to the fact that it presents notes and remarks that contribute to the flowers' keeping alive in vases as long as possible, thus helping the growers of herbaceous peony as cut flower, florists', and the people who love this flower, both with the commerce with cut flowers and the prolonged preservation of these flowers.

This research study makes known the results regarding the use of the traditional solution recipes in the vase water, in order to preserve the flowers in vases as long as possible. The quality of the cut flowers depends mainly on the flower form, color, fragrance and the mechanical resistance of the inflorescence stem. In recent years the peony has become more and more popular globally as cut flower. Millions of cut peony stems are sold annually to different countries and regions by means of auctions held in Holland. Yet, the natural blooming period of the peony is short, a fact that affects seriously its industrial development. The commune method of prolonging its

economic viability consists in its keeping at a low temperature after cutting, yet the storage time is limited (approximately 20-30 days on the average) and its quality is not stable after its storage. Therefore, it is necessary to understand the effects of the cut peony storing at low temperature and the mechanisms that form its basis, so as to improve the future post-harvest technologies.

The cut flowers are shoots detached from the mother-plant. After harvest, the link to the mother-plant is separated, and the flower shoot can no longer be supplied with water and nutrients from the mother-plant. However, the normal physiologic metabolism continues. The storage at low temperatures, which can be divided into dry storage (DS) and wet storage (WS), delays the senescence, prolongs the flowers' lifetime and reduces the caused damage to the bacteria of the flower sprays (Eason și colab., 2002; Shahri și colab., 2011).

It has been reported that some cut flowers are suitable for DS, such as roses (*Rosa hybrida* L.), whereas others are suitable for WS, that is lisianthus (*Eustoma grandiflorum* Salisb.), zinnia

(*Zinnia elegans* Jacquin) and freesia (*Freesia × hybrida* Bailey) (Ahmad et al., 2012). However, it is usually acknowledged that WS is mostly used for short-term storage (S-tS), while DS is more suitable for long-term storage (L-tS) (Ahmad et al., 2012; Reid, 2002).

During the post-harvest stage, the energy supply (mainly through starch hydrolysis and sucrose) is vital for the blooming of the flowers, and the lack of saccharides diminishes seriously the quality of the cut flowers (van Doorn, 2004). Generally, the starch can be hydrolyzed into saccharide in order to release energy, and the sucrose can also be formed in the starch to store energy (Ferne et al., 2002; Roby et al., 2002). Sucrose phosphate synthase (SPS, EC 2.4.1.14) is a key enzyme for the catalysis of the sucrose biosynthesis and affects positively the sucrose and the starch in the plants, during the bidirectional process (Grof et al., 1998; Hashida et al., 2016).

Saccharose is one of the main photosynthetic items, which is synthesized in cytosol and then transported to the plant cells, and that being hydrolyzed into glucose and fructose, so as to release energy (Gifford et al., 1984). The saccharose can be hydrolyzed by two different enzymes *in vivo*: (i) sucrose synthase (SUS, EC 2.4.1.13) and (ii) invertase (INV; EC 3.2.1.26). SUS is associated with the saccharose that is hydrolyzed reversibly into UDP-glucose and fructose in the presence of UDP (Fallahi et al., 2008; Xu et al., 2012). In some plants, SUS plays an essential part due to the sucrose that enters the cellular metabolism, and it also can be implied in the biosynthesis of the cellular wall through the supply of UDP-glucose (Craig et al., 1999; Ruan et al., 2003). INV is associated with the irreversible hydrolysis of the saccharose into glucose and fructose. INV has proved to play the main parts in the development of the plants, as well as the resistance to biotic and abiotic tensions (Kulshrestha et al., 2013; Qian et al., 2016; Ruan, 2014; Tauzin and Giardina, 2014). INV can be further divided into three functions depending on the cell location, namely cell-wall invertase (CWIN), vacuolar invertase (VIN) and cytoplasmic invertase (CIN). The WINs play essential parts in the phloem discharge, the VINs have major roles regarding

the sugar accumulation and the cell expansion, and the CINs are necessary for the development of the reproduction and the roots (Ruan, 2014; Wan et al., 2018).

In a research study, J. Xue et al. (2019) (Postharvest Biology and Technology, 155, 11–19), on “Evaluation of dry and wet storage regarding life quality of cut flowers kept in vases based on the metabolism adjustment of starch and sucrose” concludes the following:

- In comparison with the WS treatment, DS has improved significantly the life quality of the cut flowers of herbaceous peony kept in vases "Yang Fei Chu Yu" after both treatments S-tS and L-tS.
- For the S-tS treatment, the main factors that contribute to that model can be the faster consumption of starch during the storage and the sucrose hydrolysis at the beginning of the vase period.
- For L-tS treatment, the greater level of glucose and fructose at the end of the storage stage can contribute more to the higher quality of the flowers.
- The subsequent transcriptional analysis of nine representative genes for starch and the sucrose metabolism (including two SPSs, two SUSs and five INVS) have supported these conclusions.
- Based on these results, DS is recommended for refrigeration storage. This recommendation occurs regardless the storage period, as long as the storage period remains within the accepted period.

## MATERIALS AND METHODS

The research was carried out in the town of Singureni, Giurgiu County, in the personal household, in 2019. To perform this experiment a space for research was organized. The research material used in this experiment consists of peonies of some cultivars of herbaceous peony in their own gardens, as well as peonies from the University collection. The experiment was carried out in May 2019.

As research methods we used biometric measurements, findings and visual observations during the research period.

The biometric measurements were performed using the following indicators:

- Phenophase of buds;
- Diameter of buds;
- Diameter of floral shoot;
- Length of floral shoots

The visual observations were performed using the following indicators:

- Blooming phenophases (half-bloomed bud, flower blooming, complete blooming of flower, blooming closure, petal falling);
- The period of flower keeping in vase (day).

This research is two-factor experiment and consists of two elements: factor A and factor B. Factor A consists of the herbaceous peony cultivars: Festiva Maxima, Dorren, Pink Giant, Kansas. Factor B is represented by the solutions used to preserve the flowers in vases: aspirin, starch, sugar, white vinegar, vodka, hydrogen peroxide, lemon juice, mouthwash, sodium bicarbonate, carbonated juice, mineral water. By combining the two factors, 17 variants were found, which are presented in Table 1.

Table 1. Experimental variants of the research carried out in May 2019

Variaty	Cultivars	Solutions to preserve flowers
V1	Festiva maxima, Dorren, Pink Giant, Celebrity	Aspirin 1 pc/1 l of water
V2	Festiva maxima, Dorren, Pink Giant, Celebrity	3 drops of starch + 1 spoonful of sugar/1 l of water
V3	Festiva maxima, Dorren, Pink Giant, Celebrity, Kansas	3 spoonful of sugar + 2 spoonful of white vinegar/1 l of water
V4	Festiva maxima, Dorren, Pink Giant	3 – 4 drops of vodka/1 l of water
V5	Festiva maxima, Dorren, Pink Giant	1 spoonful of hydrogen peroxide/ 1 l of water
V6	Festiva maxima, Dorren, Pink Giant, Celebrity	Lemon juice 250 ml
V7	Festiva maxima, Dorren, Pink Giant, Kansas	1/4 spoonful of starch/1 l of water
V8	Festiva maxima, Dorren, Pink Giant, Kansas	1 spoonful of vinegar+ 3 spoonful of sugar + a few drops of starch/ 1 l of water
V9	Festiva maxima, Dorren, Pink Giant, Kansas	1 spoonful of vinegar+ 2 spoonful of sugar + 1 pc of aspirin/1 l of water
V10	Festiva maxima, Dorren, Pink Giant, Kansas	1 spoonful of mouthwash + 1 spoonful of sugar/1 l of water
V11	Festiva maxima, Dorren, Pink Giant, Kansas	1 spoonful of hydrogen peroxide + 1 spoonful of apple vinegar + 1 spoonful of sodium bicarbonate/ 1 l of water
V12	Festiva maxima, Dorren, Pink Giant, Kansas	2 spoonful of lemon juice /250 ml of water
V13	Festiva maxima, Dorren, Pink Giant, Kansas	250 ml carbonated juice + 250 ml water + ½ spoonful of starch/1 l of water
V14	Festiva maxima, Dorren, Pink Giant	250 ml carbonated juice
V15	Festiva maxima, Dorren, Pink Giant	Mineral water
V16	Festiva maxima, Dorren, Pink Giant	1 part of juice + 3 parts of water + 2-3 drops of starch
V17	Festiva maxima, Dorren, Pink Giant	100 g sugar/1 l of water



Picture 1. Aspect of the cut flowers at the moment of flowers' introductions into the vases with solutions belonging to some herbaceous peony cultivars, May 2019

The research material used, as well as the studied characteristics of the cultivators' flowers are represented in Table 2.

Table 2. The characteristics of the peony cut flowers kept in vases with different preservation solutions

No.	Cultivar	Length of floral shoot (cm)	Diameter of floral shoot (mm)	Phenophase of the buds at harvest	Diameter of buds (mm)
1	Festiva maxima	50-60	4-7	Colored, closed bud	25
2	Dorren	50-60	3-6	Colored, closed bud	23
3	Pink Giant	40-50	4-5	Colored, closed bud	20
4	Celebrity	30	3-4	Colored, closed bud	17
5	Kansas	50	4-5	Colored, closed bud	19



Picture 2. Aspect of flowers belonging to some cultivars of herbaceous peonies, at the moment of their introduction into vases with different solutions, 2019



Picture 3. Aspect of buds belonging to some cultivars of herbaceous peonies, at the moment of their introduction into different solutions, 2019



Picture 4. Aspect of cut herbaceous peonies at their introduction into vases with different solutions, 2019

## RESULTS AND DISCUSSIONS

This paper, with the help of the observations, measurements and findings performed during the research, led to some conclusions regarding the blooming phenophases of the herbaceous peony cultivars, the petal aspect after blooming, but especially the lifetime of the flowers kept in vases with different solutions (blooming duration).

The results obtained on the blooming phenophases are presented separated for each cultivar.

The blooming phenophases for the cultivar *Festiva maxima* and the lifetime of the flowers in vases are presented in table 3. It can be observed that variant V3 has a period of 5 days in vase until the flower blooming. It was noticed that the maximum lifetime of the flowers in vases was of only 5 days, and the maximum lifetime of the flowers in vases for V4 was of 11 days, respectively a lifetime period of 10 days with variants V7 and V8.

Table 3. Blooming phenophases for the cut peony flowers kept in different solutions, cultivar *Festiva maxima*, May 2019

Variant/ phenophase	Date of flowers' introduction into vases	Half- bloomed colored bud	Blooming of flowers	Complete blooming of flowers	End of blooming	Aspect of petals	Blooming duration (days)
V1	20.05	22.05	23.05	24.05	30.05	falling	8
V2	20.05	22.05	23.05	24.05	29.05	falling	7
V3	20.05	23.05	25.05	26.05	01.06	falling	8
V4	20.05	21.05	22.05	23.05	01.06	falling	11
V5	20.05	22.05	23.05	24.05	27.05	falling	5
V6	20.05	22.05	24.05	26.05	31.05	falling	8
V7	20.05	22.05	24.05	25.05	02.06	falling	10
V8	20.05	22.05	23.05	24.05	01.06	falling	10
V9	20.05	22.05	23.05	24.05	30.05	falling	8
V10	20.05	22.05	24.05	25.05	31.05	falling	8
V11	20.05	22.05	23.05	24.05	30.05	falling	8
V12	20.05	22.05	23.05	24.05	31.05	falling	9
V13	20.05	21.05	22.05	23.05	29.05	falling	8
V14	20.05	21.05	22.05	23.05	28.05	falling	7
V15	20.05	21.05	22.05	23.05	30.05	falling	9
V16	20.05	22.05	23.05	24.05	31.05	falling	9
V17	20.05	21.05	22.05	23.05	30.05	falling	9

Having analyzed the data presented in Table 4 on the flowers' duration in the vases for the *Dorren* cultivars, it can be noticed a period of 2 or three days of the herbaceous peony buds in vases till the blooming beginning. Also, it can be noticed a minimum lifetime of the peonies in vases at the variants: a lifetime of 7 days for the variants V1, V4, V11, and V12. The maximum lifetime noticed for the Variant V7 of peonies in vases of 11 days, followed by variants V13, V15, V16 with a lifetime of only 10 days.

Table 4. Blooming phenophases for the cut peonies kept in different solutions, cultivar *Dorren*, May 2019

Variant/ Phenophase	Date of flowers' introduction into vases	Half- bloomed colored bud	Blooming of flowers	Complete blooming of flowers	End of blooming	Aspect of petals	Blooming duration (days)
V1	20.05	22.05	23.05	24.05	29.05	petal wilting	7
V2	20.05	21.05	22.05	23.05	29.05	falling	8
V3	20.05	21.05	22.05	23.05	30.05	falling	9
V4	20.05	22.05	23.05	24.05	29.05	falling	7
V5	20.05	21.05	22.05	23.05	30.05	petal wilting	9
V6	20.05	21.05	22.05	23.05	30.05	petal wilting	9
V7	20.05	21.05	22.05	23.05	01.06	falling	11
V8	20.05	21.05	22.05	23.05	30.05	petal wilting	9
V9	20.05	21.05	22.05	23.05	29.05	falling	8
V10	20.05	21.05	22.05	23.05	29.05	falling	8
V11	20.05	22.05	23.05	24.05	29.05	petal wilting	7
V12	20.05	22.05	23.05	24.05	29.05	falling	7
V13	20.05	21.05	22.05	23.05	31.05	falling	10
V14	20.05	21.05	22.05	23.05	30.05	falling	9
V15	20.05	22.05	23.05	24.05	01.06	falling	10
V16	20.05	21.05	22.05	23.06	31.05	falling	10
V17	20.05	21.05	22.05	23.05	30.05	petal wilting	9

Having analyzed the data presented in Table 5 on the lifetime of the flowers in vases for the cultivar *Pink Giant*, it can be noticed a duration of 1 and 2 days in vase of the herbaceous peony buds till the blooming start. Also, it can be noticed a minimum lifetime of 8 days for the



peony flowers in vases of the variants: V6 and V12. It was noticed a maximum lifetime period of 11 days of the peony buds in vases for the variants V5, V8, V9, V10, V11 and V15, followed by a period of only 10 days for the variants V2, V4, V13 and V14.

Table 5. Blooming phenophases of cut peonies kept in different solutions, cultivar Pink Giant, May 2019

Variant/ phenophase	Date of flowers' introduction into vases	Half- bloomed colored bud	Blooming of flowers	Complete blooming of flowers	End of blooming	Aspect of petal	Blooming duration (days)
V1	20.05	22.05	23.05	24.05	31.05	falling	9
V2	20.05	22.05	23.05	24.05	01.06	falling	10
V3	20.05	21.05	22.05	23.05	30.05	falling	9
V4	20.05	22.05	23.05	24.05	01.06	falling	10
V5	20.05	21.05	22.05	23.05	01.06	falling	11
V6	20.05	22.05	23.05	24.05	30.05	falling	8
V7	20.05	21.05	22.05	23.05	30.05	falling	9
V8	20.05	21.05	22.05	23.05	01.06	falling	11
V9	20.05	21.05	22.05	23.05	01.06	falling	11
V10	20.05	21.05	22.05	23.05	01.06	falling	11
V11	20.05	21.05	22.05	23.05	01.06	falling	11
V12	20.05	22.05	23.05	24.05	30.05	falling	8
V13	20.05	21.05	22.05	23.05	31.05	falling	10
V14	20.05	22.05	23.05	24.05	01.06	falling	10
V15	20.05	21.05	22.05	23.05	01.06	falling	11
V16	20.05	21.05	22.05	23.05	30.05	falling	9
V17	20.05	21.05	22.05	23.05	30.05	falling	9

It can be observed from the data presented in Table 6 on the lifetime of peony flowers in vases for the cultivar Kansas that the blooming of flowers took place after 1 and 2 days since their introduction in vases with different solutions. Continuing the analysis of Table 6, it can be noticed a minimum lifetime of 7 days for the peony flowers, variant V13, and a maximum period of 10 days to keep peony flowers for the variants V10 and V12.

Table 6. Blooming phenophases of the cut flowers kept in different solutions, cultivar Kansas, May 2019

Variant/ phenophase	Date of flowers' introduction into vases	Semi- open colored bud	Blooming of flowers	Complete blooming of flowers	End of blooming	Aspect of petal	Blooming duration (days)
V3	20.05	21.05	22.05	23.05	29.05	falling	8
V7	20.05	21.05	22.05	23.05	30.05	falling	9
V8	20.05	21.05	22.05	23.05	29.05	falling	8
V9	20.05	22.05	23.05	24.05	30.05	falling	8
V10	20.05	22.05	23.05	24.05	01.06	falling	10
V11	20.05	22.05	23.05	24.05	30.05	falling	8
V12	20.05	22.05	23.05	24.05	01.06	falling	10
V13	20.05	22.05	23.05	24.05	29.05	falling	7

After analyzing the data presented in Table 7 on the lifetime of the flowers kept in vases for the cultivar Celebrity, it can be noticed that there is a period of 1 and 2 days in vases of the herbaceous peony buds till the blooming start. Also, it can be noticed a minimum lifetime of 6 days for the peony flowers kept in vases for variant V1. It was noticed a maximum lifetime of 8 days for peony flowers kept in vases,

variants V3 and V6, followed by a lifetime period of only 7 days for variant V2.

Table 7. Blooming phenophases of the cut peonies kept in different solutions, cultivar Celebrity, May 2019

Variant/ phenophase	Date of flowers' introduction into vases	Half- bloomed colored bud	Blooming of flowers	Complete blooming of flowers	End of blooming	Aspect of petals	Blooming duration (days)
V1	20.05	21.05	22.05	23.05	27.05	falling	6
V2	20.05	22.05	23.05	24.05	29.05	falling	7
V3	20.05	21.05	22.05	23.05	29.05	falling	8
V6	20.05	21.05	22.05	23.05	29.05	falling	8



Picture 5. Aspect of flowers kept in vases with different solution, variants V1-V3, May 2019



Picture 6. Aspect of flowers kept in vases with different solutions, variants V4-V7, 2019

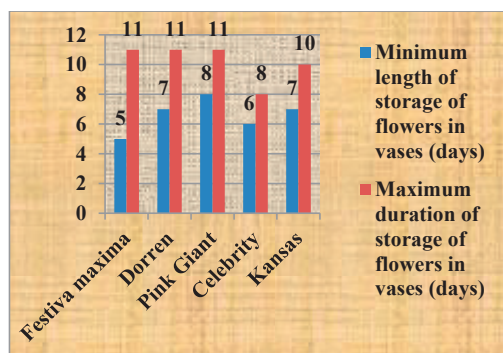


Picture 7. Aspect of flowers kept in vases, blooming of flowers, variants V1-V11, May 2019



Picture 8. Aspect of flowers in vases, blooming of flowers, variants V12-V17, May 2019

Observing the data in Picture 9 on lifetime of the flowers kept in vases with different solutions, it results a minimum lifetime period between 5 day for cultivar Festiva maxima, and a period of 8 days for the cultivars Pink Giant and Celebrity, as well as a lifetime period of the flowers between 8 days for the variant Celebrity and 11 days for the cultivars Festiva maxima, Dorren and Pink Giant



Picture 9. Lifetime period of the flowers kept in vases of some herbaceous peony cultivars



Picture 10. Aspect of flowers kept in vases, blooming of flowers, variants V1-V3, May 2019



Picture 11. Aspect of flowers in vases, blooming of flowers, variants V3-V6, May 2019



Picture 12. Aspect of flowers kept in vases, complete blooming of flowers, variants V1-V11, May 2019



Picture 13. Aspect of flowers kept in vases, flower complete blooming, V1-V11, May 2019



Picture 14. Aspect of blooming in vases, flower complete blooming, V12-V17, May 2019



Picture 15. Aspect in blooming in vases, complete flower blooming, variants V15-V17, May 2019



Picture 16 Aspect of flowers, blooming end and petal falling, May 2019



Picture 17. Aspect of flowers in vases, blooming end and petal fallings, May 2019



Picture 18. Blooming end and petal falling, May 2019

## CONCLUSIONS

The research carried put led to the following conclusions:

- For cultivar Festiva maxima, the minimum period to preserve the flowers in vases was of 5 days for V5, and the maximum period to preserve the flowers in vase was of 11 days for V4 and 10 days for V8.
- For cultivar Dorren, the minimum period to preserve the flowers in vases was of 7 days for V1, V4, V11, V12, and the maximum period of flower preservation in vases was of 11 days for variant V7, followed by a period of only 10 days for the variants V13, V15, V16.
- For cultivar Pink Giant, the minimum preservation period was as follows: 8 days for the variants V6 and V12, and the maximum period of flower preservation in vases was of 11 days for the variants V5, V8, V9, V10, V11 and V15, followed by a period of only 10 days for the variants V2, V4, V13 and V14.
- For cultivar Kansas, the minimum flower preservation period was of 7 days for variant V7, and the maximum peony preservation period was of 10 days for variants V10 and V12.
- For cultivar Celebrity, the minimum flower preservation period was of 6 days for variant V1, and the maximum peony preservation period was of 8 days for the variants V3 and V6, followed by a period of only 7 days for the variant V2.
- The best solutions to preserve flowers in vases were those for variants V11, V10, V7, V8, V13, and V15.
- On a smaller scale, the traditional solutions can be recommended to preserve the flowers in vases for as long as possible.

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