CORVINUS
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Faculty of Horticultural Science

Thesis of PhD Dissertation

THE IMPACT ASSESSMENT OF PROCEDURES, WHICH INCREASE THE VASE LIFE OF CUT FLOWERS, IN THE CASE OF CARNATION AND ROSE FLOWERS.

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The applicant met the requirement of the PhD regulations of the Corvinus University of Budapest and the thesis is accepted for the defence process.

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1. THE PREMISE AND MAIN GOALS OF THE RESEARCH

The flowers had an important role in our life since the ancient times, because the prehistoric men decorated their environment and themselves with flowers. They are attached to innumerable occasions and events because of our birth until our death.

A diverse emotion and mood are able to be expressed by the flowers. We use them for special occasions (ex.: birthday, wedding), feast (ex.: Mothers' Day, Easter), expression of the pain of passing, and for decoration in our home and workplace.

The quality is increasingly more important beside the form and the colour. The customers expect it nowadays, that the bought flowers have to keep their ornamental value until the longest time. Because of this the careful work of grower and the suitable transportation are indispensable, since the cut rose and carnation are cultivated on those areas where the climate is suitable, relatively cheap the manpower, hereby thought the growing more efficient and excellent the quality.

The largest part of the flowers arrives by import into Europe (ex.: from Kenya, Columbia, Ecuador, Israel, etc.). They arrive through even more traders, it takes 5-7 days that the cut flower arrives from the growing country to the costumer. Because of these the most important question the examination of the vase lifetime for the conservation of the quality.

After harvest different physiological changes happen in the flowers, which processes if we recognise it, and we can influence it, then the life of the flowers extendible, and his ornamental value can be preserved.

The cut flowers form a more complex system like the fruits and vegetables, since not only have a leaf, but they consist of flower as well. While in most cases we harvest the fruits and vegetables maturely, after the ending of their development, and then the retardation of their ageing the aim, till then the cut flowers mostly are in budded, because of this to the increase of their lifetime two kind of things have to be considered, the treatments aimed et opposite purpose: in the first section the promotion of the increase and flowering processes, in the second the retardation and prevention of processes of ageing.

Currently in Hungary the chemicals that were good they were banned (ex.: silver-thiosulphate), like this especially important the examination of the effect of those compounds, which ones are in trade nowadays.

In Hungary the application of cut flower preservatives is hardly used. Different commercial preservatives are used only in some flower shops. One of the reasons of this the heavy economic situation, other reason, that their effect is not known. Provide of obtaining the commercial preservatives would be important for the customers, and the development of solutions which ones cheaply, quickly preparable at home.

OBJECTIVES

1. Development of new preservatives, and comparison of the effect of these chemicals to the commercial preservatives.
2. Study the effect of 1-MCP treatment of different duration and temperature.
3. Study the effect of 1-MCP applications in combination with other treatments.
4. Work out of a method to determine the objective state of the leaves and the flowers.
5. Definition an ornamental value of cut flowers, which incorporates more measurement results in a formula.
6. Definition of the chlorophyll content and the SPAD value of the leaves.

3. MATERIALS AND METHODS

3.1 The place and timing of the experiment

The experiments were carried out in the laboratory of the Department of Floriculture and Dendrology, Faculty of Horticultural Sciences, Corvinus University of Budapest, duration March 2008. - February 2011.

3.2 The species used for the experiments

- 3 experiments with 2 variety of carnation:

  Dianthus caryophyllus 'Gioko' and 'Reina'

- 7 experiments with 6 variety of rose:

  Rosa x hybrida 'Happy Hour', 'Bordeaux', 'Red Paris', 'La Belle', 'Milonga' and 'Mariyo'

3.3. The chemicals used

The compounds for the preservation of flowers were the followings:

- Spring; Chrysal; Floralife commercial preservatives
- 1, 1,5, 2 and 2,5 mlL^{-1} Clorox;
- 10, 20, 30, 40 and 50 gL^{-1} sucrose;
- 0,5 gm^{-3} 1-MCP for 6 and 18 hours;
- 10, 25, 50, 75, 100, 125, 150, 200, 250 and 500 mgL^{-1} salicylic acid;
- 1, 2, 4, 8 mgL^{-1} benzyl-adenine;
- and the old Chrysal*, its compounds: 23 gL^{-1} sucrose, 1 gL^{-1} potassium chloride, 1 gL^{-1} aluminium-sulphate.

3.4. The experienced parameters

I examined the following parameters in the course of the samplings:

- the pH of the solutions, their transparent ability and the water intake;
- the SPAD value, the chlorophyll content and the state of the leaves
- the sugar content of the stem and the petals
- the flower diameter and the flower state
- and finally the vase lifetime and decorator value.

The statistical analysis was made on the 95% significance level ($p<0,05$) with Ropstat and SPSS statistical programs. The one factor analysis of variance and Duncan test were applying. On the graphs the square values were indicated too.

The received data were fixed in the Microsoft Excel documents, and I presented it with the help of graphs.

4. RESULT AND DISCUSSION

4.1. The created methods

4.1.1. Determination the state of leaves (my method)

To describe the change of the state leaves I created a scale with five degrees: 5 = totally intact leaves, 4 = beginning, palpable withering, 3 = visible withering, 2 = intense withering, 1 = leaves died away. The sate of the leaves was determined next to standard daylight.

4.1.2 Determination the state of leaves (my method)

To describe the change of the ornamental value of the flowers I created a scale with five degrees: 5 = totally intact flower, 4 = beginning, palpable withering, 3 = visible withering, 2 = intense withering, 1 = flower died away. The sate of the flowers was determined next to standard daylight

4.1.3 Determination of the vase life (my method)

As regards to the vase life, the flowers were considered as to be valueless (ripe for throwing out), when they reached the 3rd grade, the flowers dropped their good value. Every case of the flowers I described the vase lifetime and for the treatments I calculated the means.

4.1.4 Determination of the ornamental value (my method)

In the case of treatments I used the mean of the examined parameters and determined the order of the importance: chlorophyll content (CH), diameter of flowers (DF) state of the flowers (SF), vase life (VL). The ornamental value (OV) was calculated with the next formula and was expressed in points:

$$OV = 1 \times CH + 2 \times DF + 3 \times SF + 4 \times VL$$

The higher of this value the higher ornamental value has the flower.

4.2. The effect of the Clorox, the sucrose and the 1-MCP in the case of Dianthus caryophyllus 'Gioko'

The experiment with *carnation* '***Gioko'*** had 14 treatments, had 4 replications of 20 flowers. The evaluations were made with 4 occasions. It can be concluded that the highest vase life (18.33 days) was obtained by using 1-MCP. This difference (10 days) is very considerable compared to the distilled water (8.7 days). Similar results were obtained by using Spring (17.7 days), 10 and 20 gL^{-1} sucrose with 1-MCP treatments (17.3 and 17.1 days). These treatments increased the vase-life by 8 days.

4.3. The effect of the Clorox and the sucrose in the case of Dianthus caryophyllus 'Reina'

The experiments with *carnation* '***Reina'*** had 18 treatments, had 3 replications of 10 flowers. The evaluations were made with 4 occasions. The highest vase life was obtained by using 1.5 and 2 mlL^{-1} Clorox: 18.1 and 17.7 days, which increased the vase life by 4 and 5 days compared to the distilled water. The treatments were better than Spring commercial preservative with 12.4 days vase life.

4.4. The effect of salicylic acid in the case of Dianthus caryophyllus 'Reina'

The experiments with *carnation* '***Reina'*** had 14 treatments, had 3 replications of 10 flowers. The evaluations were made with 3 occasions. With this experiment it can be concluded the salicylic acid can increase the vase-life of cut flowers: 125 mgL^{-1} salicylic acid concentrations proposed, in which case the flowers decorated until 11.1 days. The vase life of the flowers can be increased with 2.4 days compared to the distilled water. The effect of salicylic acid was not significantly different compared to the commercial preservatives (Floralife, Spring), or was better than they.

4.5. The effect of the Clorox, the sucrose and the 1-MCP in the case of Rosa x hybrida 'Happy Hour' and 'Bordeaux'

The experiment with *rose* ***'Happy Hour'*** had 15 treatments, had 4 replications of 20 flowers. The evaluations were made with 4 occasions. The flowers of the distilled water destroyed with the passing of a week. But in the case of the Spring and the Clorox + 20 gL^{-1} sucrose with 1-MCP the flowers kept their good state until 10 days, which treatments can increase the vase life by 3 days.

The two experiments with *rose* '***Bordeaux'*** had 14 treatments. In the first experiment import flowers were use, and Hungarian ones in the second. The experiments had 3 replications of 20 flowers. The evaluations were made with 3 and 4 occasions. In both case Clorox + 20 gL^{-1} sucrose, Clorox + 20 gL^{-1} sucrose + 1-MCP (18 hours) and Spring solutions proved to be the best, between them significant difference cannot be manifested. Their vase life was 9-11.2 days, which one increased the vase life with 2-3 days compared to the distilled water.

4.6. Comparison of commercial preservatives, and the salicylic acid in the case of Rosa x hybrida 'Red Paris' and 'La Belle'

In the case of *rose* ***'Red Paris'*** and ***'La Belle'*** 7 treatments were used, with 3 replication of 20 flowers. The evaluations were made with 5 and 6 occasions. It can be concluded that the salicylic acid did not yield the expected result neither 50, nor in 100 mgL^{-1} of concentrations. From among the three commercial preservatives Floralife usage proposed, because in the case of 'Red Paris' increased the vase life by 6.4 days, and in the case of 'La Belle' extended by 9.1 days, compared to the distilled water. The Floralife extended the vase life of flowers by 2.7 and 1.9; 1.3 and 3.8 days compared to the Spring and Chrysal commercial preservatives.

4.7. Comparison of the effect of the commercial preservatives, and the benzyl-adenine and 1-MCP in the case of Rosa x hybrida 'Milonga' and 'Mariyo'

4.7.1 Rosa x hybrida 'Milonga'

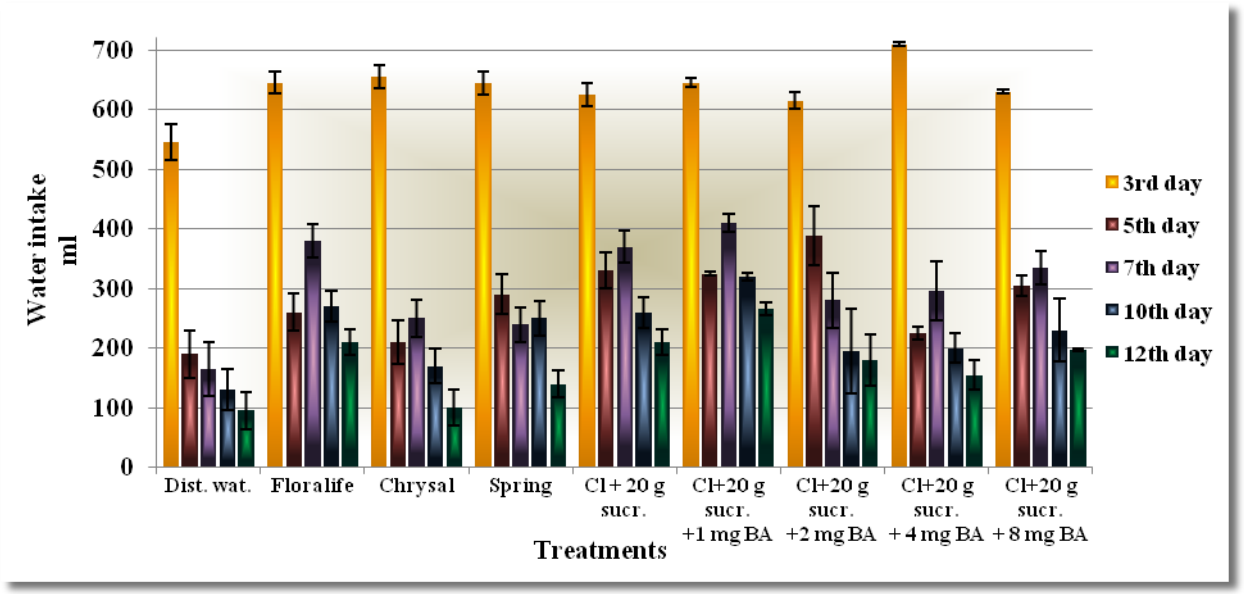
The experiments with *rose* '***Milonga'*** had 14 treatments, had 3 replications of 20 flowers. The evaluations were made with 6 occasions. I established that Floralife proved to be the best treatment in the look of the results, which case the lifetime of the flowers increased by 6.9 days compared to the distilled water (11.5 days). Similar results were obtained by using Clorox + 20 gL^{-1} sucrose + 8 mgL^{-1} benzyl-adenine, which treatment extended the life of the flowers by 4 days. The effect of this treatment was significantly better compared to the commercial preservatives (increasing the vase life by 1 and 2.5 days).

4.7.2 Rosa x hybrida 'Mariyo' – February 2011.

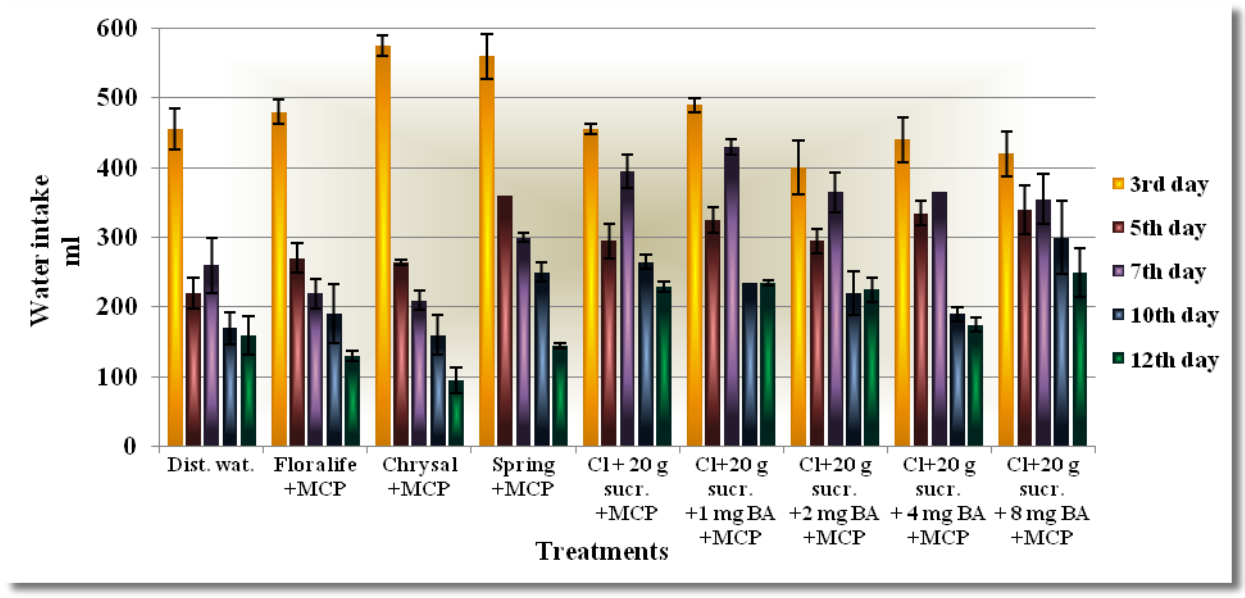
The experiments with rose 'Mariyo' had 18 treatments, had 3 replications of 20 flowers. The evaluations were made with 5 occasions. I present this experiment in detail.

4.7.2.1 Water intake

The water intake of the flowers decreased largely after the 3rd days, the plants were able to be absorbed quasi half water quantity. On the 4.1 and 4.2 figure can be seen, that the Clorox solutions with 1-MCP treatment influenced the water intake positively. In the case of benzyl-adenine I was not able to find a difference between the applied concentrations. The bigger water quantity measured on the 7th day is account for filling up the vases with fresh solutions.



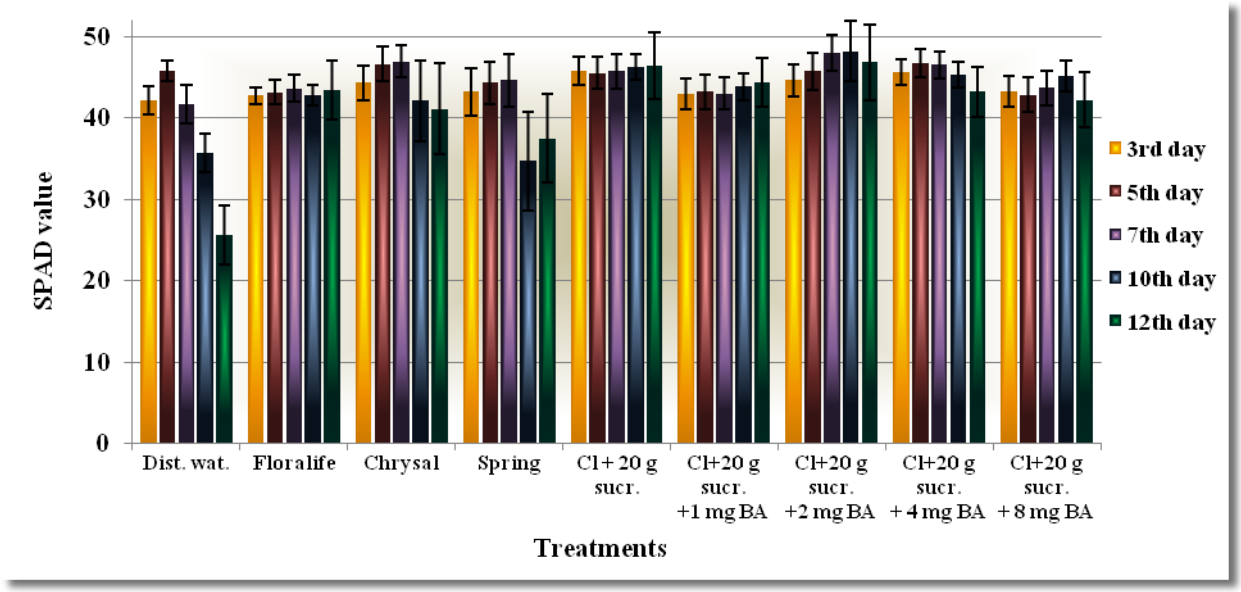
4.1. Figure The water intake of the flowers during the experiment of 'Mariyo' 1.



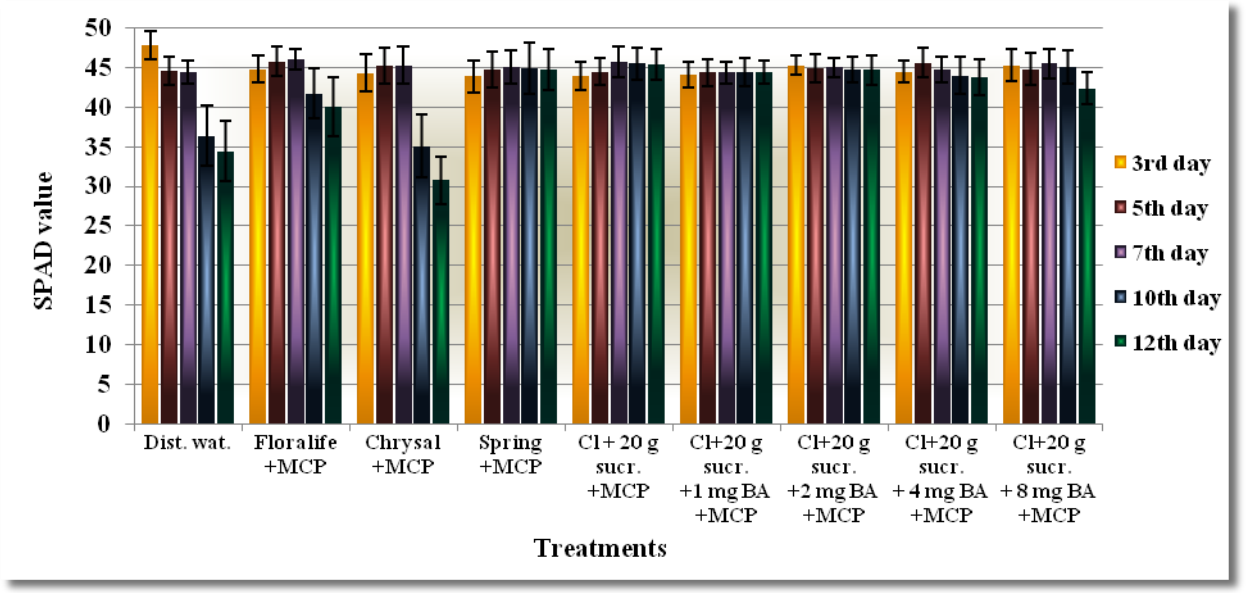
4.2. Figure The water intake of the flowers during the experiment of 'Mariyo' 2.

4.7.2.2 The SPAD value

In the case of SPAD values of leaves I measured a smaller difference during the experiment and comparing the solutions too (4.3 and 4.4 figure). I observed only in the case of the distilled water, the Spring and the Chrysal + 1-MCP more considerable decrease on the 10th day of the experiment, the leaves in the other solutions kept their green colour longer.



4.3. Figure: The SPAD values of the leaves in the case of 'Mariyo' 1.

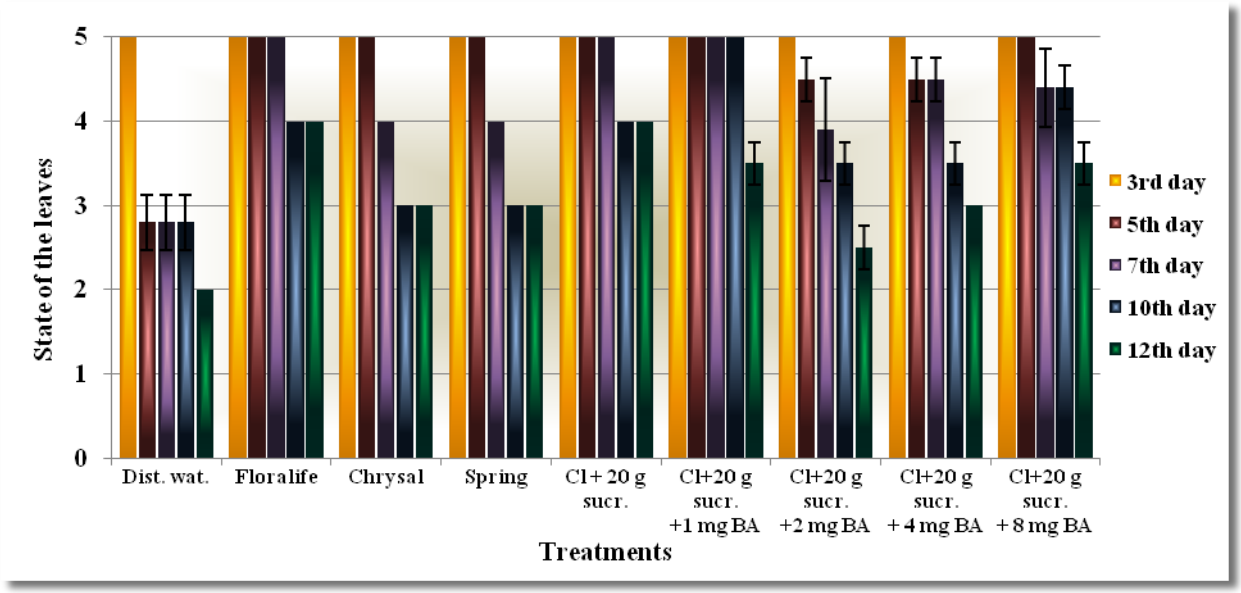


4.4. Figure: The SPAD values of leaves in the case of 'Mariyo'2.

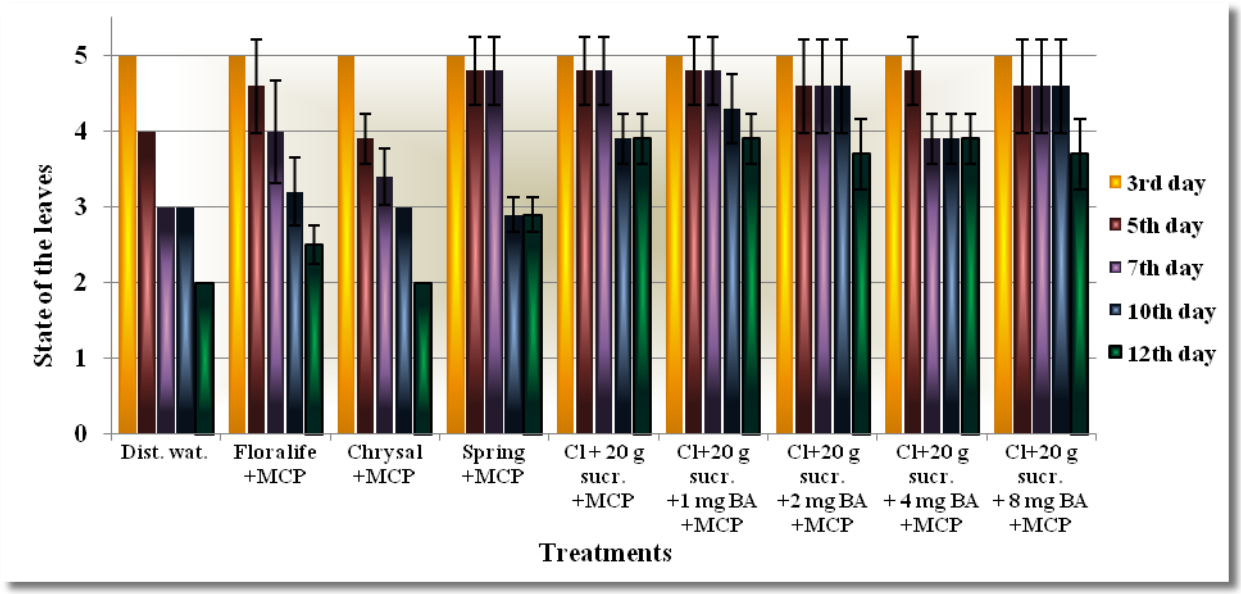
4.7.2.3 The state of the leaves

The leaves kept their good state in all of the solutions until the 3rd day of the experiment. The leaves damaged in the distilled water soon. In the case of solutions without 1-MCP treatment the Floralife and Clorox + 20 gL^{-1} sucrose + 1 mgL^{-1} benzyl-adenine proved to be the most effective, because in these cases the leaves had a maximum value on the 7th and 10th day (4.5 and 4.6 figure).

The application of the 1-MCP treatment and the Floralife and Chrysal preservatives together affected the state of the leaves slightly harmfully. The 1-MCP insured a small improvement in the case of the Clorox solutions, thereby that at the time of a last assessment the state of the leaves had a taller value compared to te solutions without the treatments.



4.5. Figure: The change of the state of the leaves of 'Mariyo' 1.

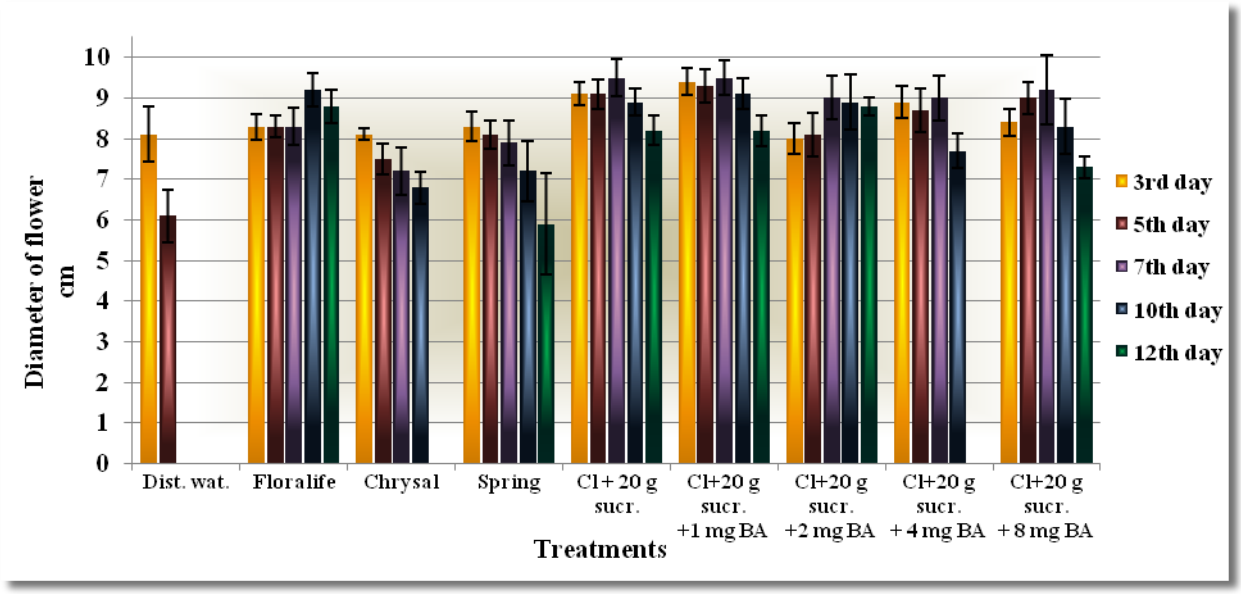


4.6. Figure: The change of the state of the leaves of 'Mariyo' 2.

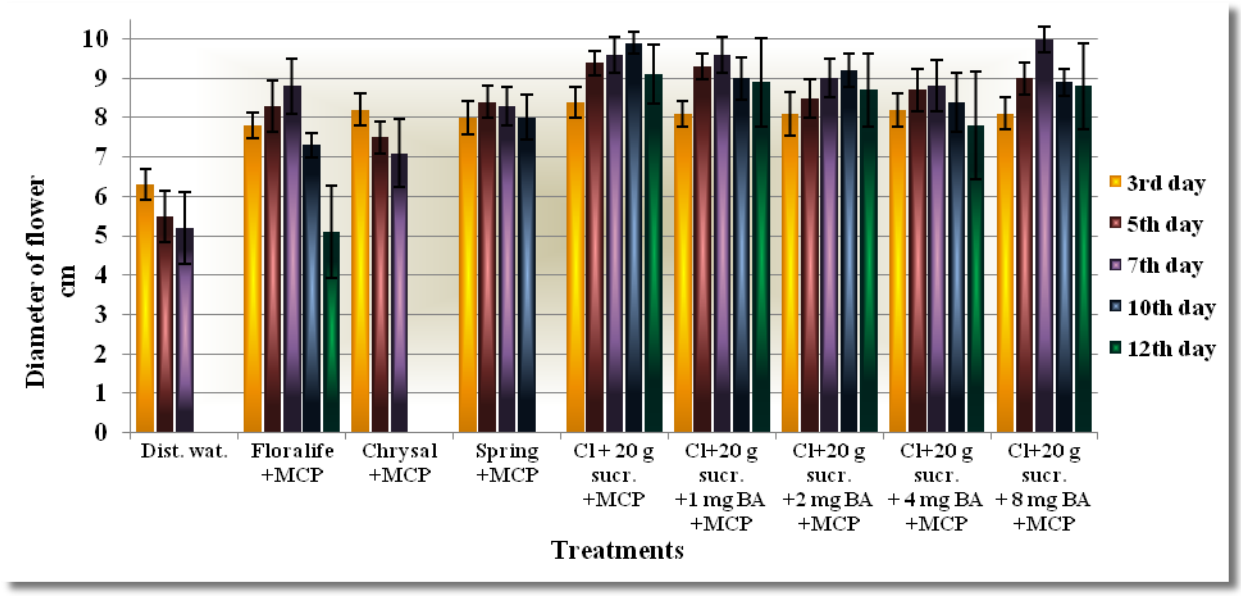
4.7.2.4 The diameter of the flowers

The diameters of the flowers were smaller in the distilled water and in the case of Chrysal and Spring preservative solutions – completed with 1-MCP treatment too – were exceeded hardly the 8 cm. Opposite this the flowers were bigger than 1 cm in the other solutions. Compared to the distilled water the application of 1-MCP treatment the diameter of flowers become bigger with 2 cm.

The flowers become biggest - more than 10 cm - in the case of Clorox + 20 gL^{-1} sucrose + 1-MCP, and Clorox + 20 gL^{-1} sucrose + 8 mgL^{-1} benzyl-adenine + 1-MCP solutions.



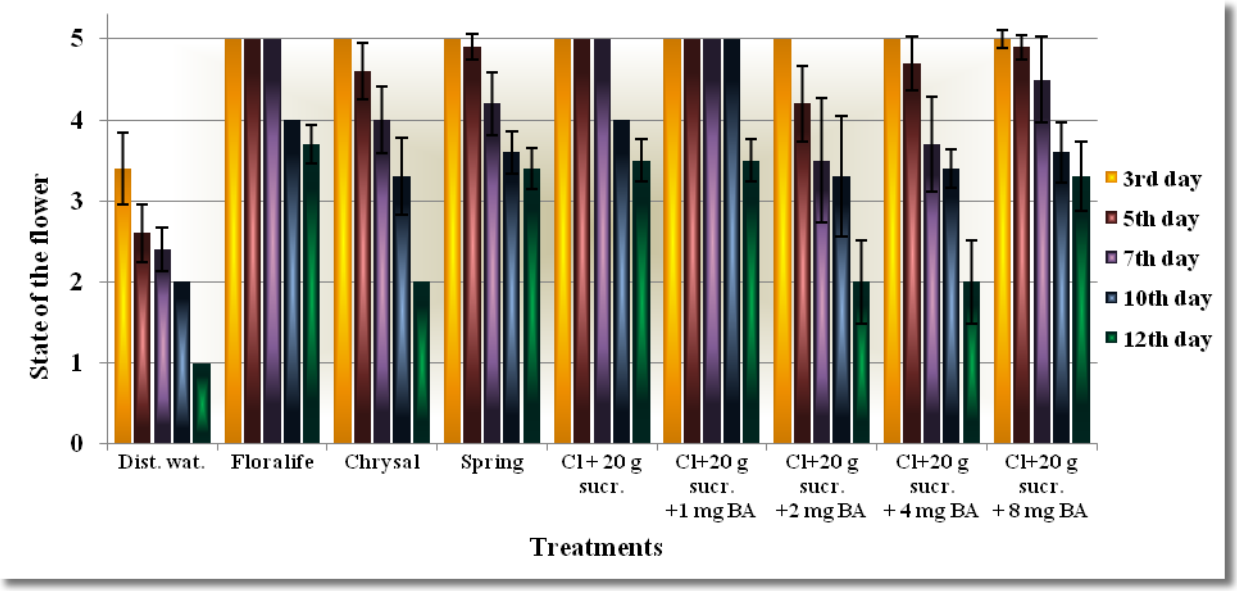
4.7. Figure The diameter of flowers during the experiment of 'Mariyo' 1.



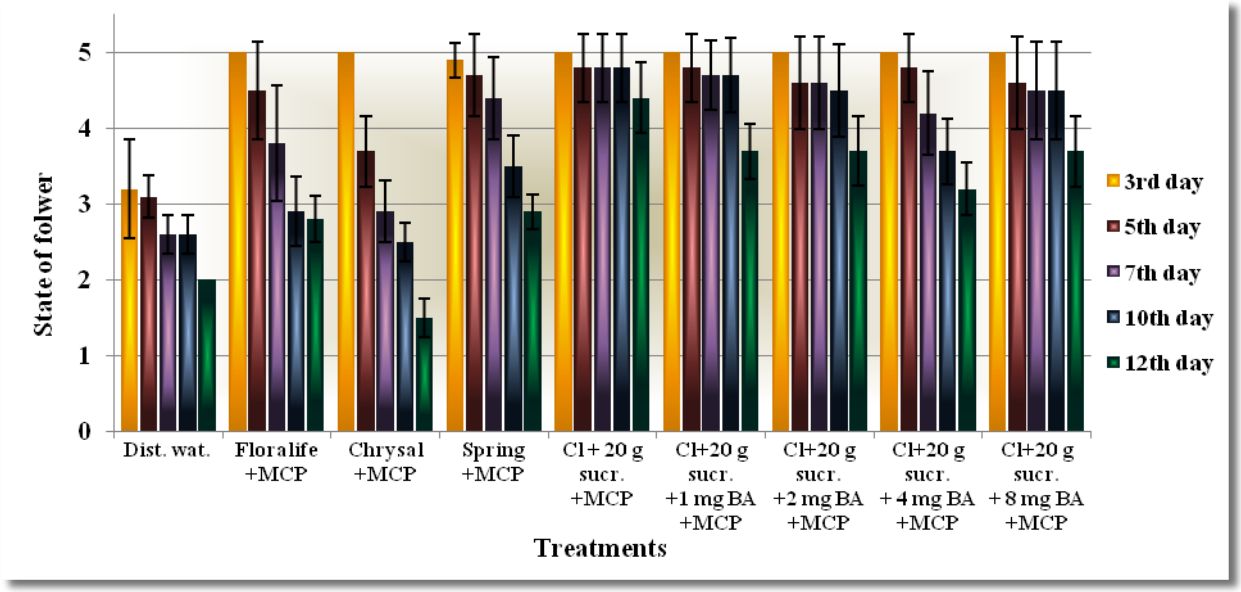
4.8. Figure The diameter of flowers during the experiment of 'Mariyo' 2.

4.7.2.5 The state of the flowers

From the state of the flowers can be related, that the flowers in the distilled water very soon, already onto the 3rd day damaged totally, yet due to the 1-MCP treatment too. The flowers preserved their good state in the case of Floralife, Clorox + 20 gL^{-1} sucrose, and Clorox + 20 gL^{-1} sucrose + 1 mgL^{-1} benzyl-adenine solutions. The 1-MCP treatment was effective only in the case of Clorox solutions: the state of flowers was in decline later, and then they did not go totally damaged by the 12th day. The commercial preservative solutions with 1-MCP treatment leaded to state decay with a smaller measure in the case of the variety 'Mariyo' (4.9 and 4.10. figure).



4.9. Figure The change of the state of the flowers of ’Mariyo’ 1.

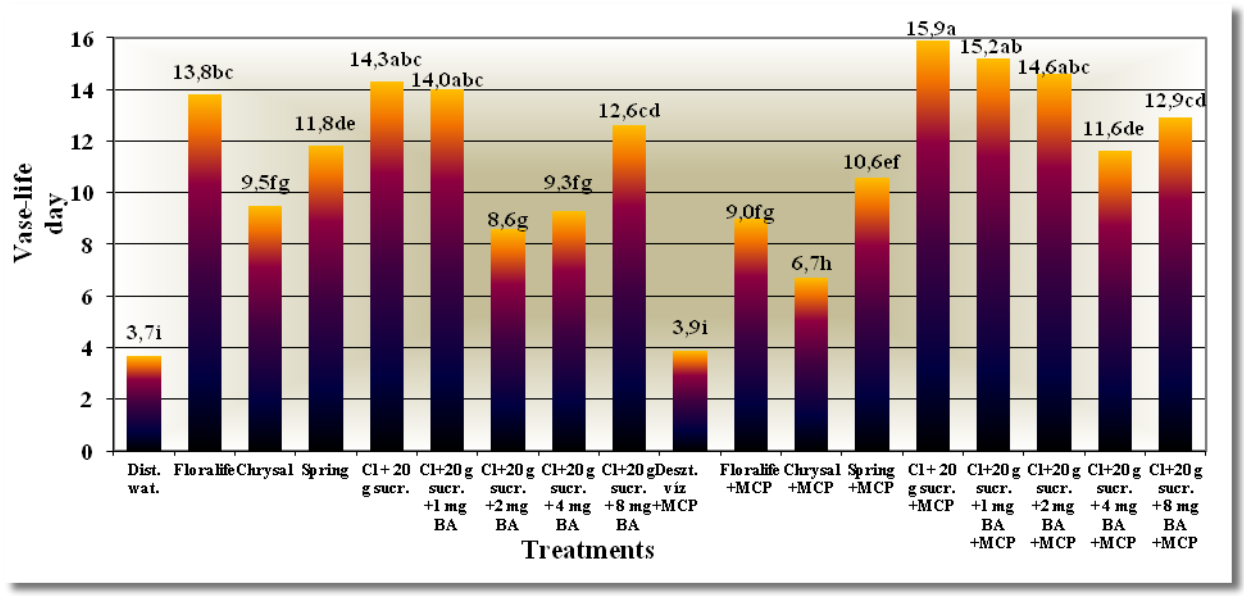


4.10. Figure The change of the state of the flowers of ’Mariyo’ 2.

4.7.2.6 The vase-life

In the case of vase-lifetime I established that the flowers ‘Mariyo’ were viable only averagely 3.9 days in distilled water. Among the commercial preservatives the Floralife proved to be the most effective one (13.8 days).

Among the solutions, which one I compiled the best result was received in the case of Clorox + 20 gL^{-1} sucrose with 1-MCP treatment, in which one the flowers decorated averagely 16 days. I achieved similarly good results in the case of the Clorox + 20 gL^{-1} sucrose + 1 mgL^{-1} benzyl-adenine solution, and with 1-MCP treatment too, which cases the flowers were alive 14 and 14.6 days. The effect of these solutions proved to be much better, than the preservatives which can be buy in the trade.



4.11. Figure The vase life of the flowers at the effect of different treatments of 'Mariyo'

4.7.2.7 The ornamental value

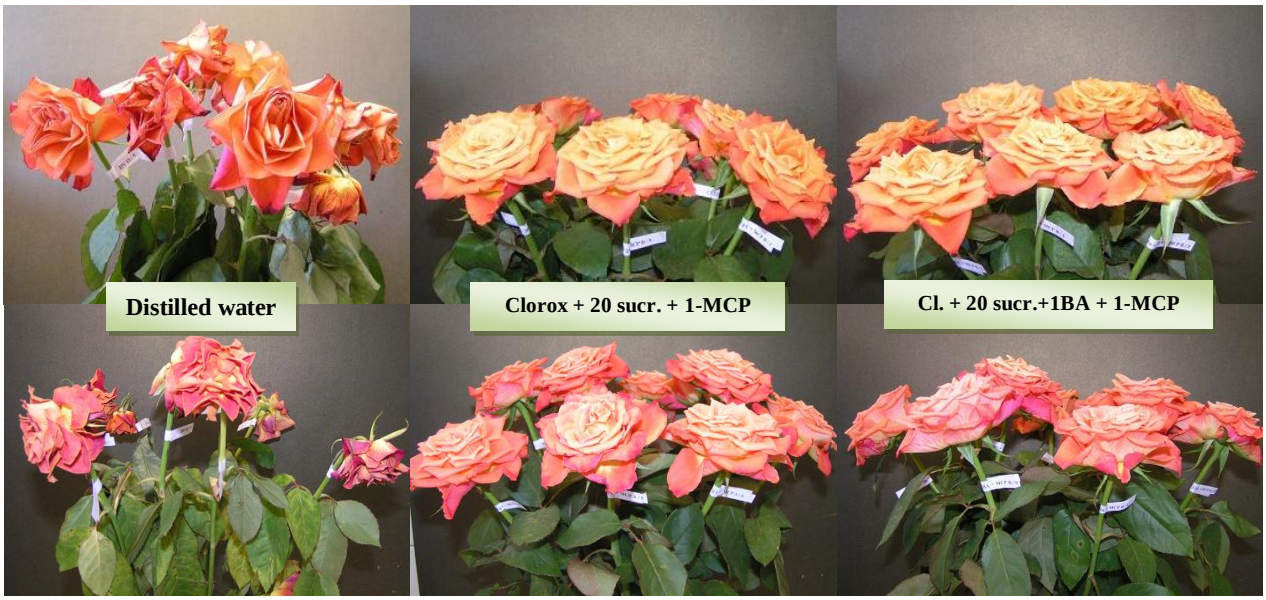
I achieved the largest ornamental values (4.12. Figure) in the case of Clorox + 20 gL^{-1} sucrose – with and without 1-MCP treatment too (141.5 and 134.6) – and Clorox + 20 gL^{-1} sucrose + 1 mgL^{-1} benzyl-adenine (136.2) solutions. These values were quasi double compared to the value of the distilled water (4.1 Table).

4.1. Table The ornamental values of the flowers in the case of 'Mariyo'

KEZELÉSEK	*DÍSZÍTŐ-ÉRTÉK*
1. Distilled water (controll)	74
2. Distilled water + 1-MCP	76,6
3. Floralife	129,1
4. Floralife + 1-MCP	106,1
5. Spring 10 gL^{-1}	115,7
6. Spring 10 gL^{-1} + 1-MCP	115,7
7. Chrysal	108,3
8. Chrysal + 1-MCP	91,5
9. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose	**134,6**
10. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose + 1-MCP	**141,5**
11. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose + 1 mgL^{-1} benzyl-adenine	131,8
12. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose + 2 mgL^{-1} benzyl-adenine	109,1
13. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose + 4 mgL^{-1} benzyl-adenine	111,1
14. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose + 8 mgL^{-1} benzyl-adenine	123,4
15. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose + 1 mgL^{-1} benzyl-adenine + 1-MCP	**136,9**
16. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose + 2 mgL^{-1} benzyl-adenine + 1-MCP	134,2
17. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose + 4 mgL^{-1} benzyl-adenine + 1-MCP	120,3
18. 2 mlL^{-1} Clorox + 20 gL^{-1} sucrose + 8 mgL^{-1} benzyl-adenine + 1-MCP	127,6

I received good results the addition to the benzyl-adenine that increased the ornamental value compared to the distilled water, and I had even better result complementing with 1-MCP treatment. The 1-MCP treatment was not effective enough in the case of distilled water and the Spring solution.

Used the 1-MCP together with Chrysal and Floralife preservatives slightly decreased the ornamental values of the flowers. Among the commercial preservatives the Floralife proved to be the best with a 129.1 value.



4.12. Figure The state of the flowers in distilled water, Clorox + 20 gL^{-1} sucrose + 1-MCP, and the Clorox + 20 gL^{-1} sucrose + 1 mgL^{-1} benzyl-adenine + 1-MCP solutions in the case of 'Mariyo' on the 5^{th} and 12^{th} days of the experiment.

4.8 NEW SCIENTIFIC ACHIEVEMENTS

1. I applied and examined first the effect of applying the 1-MCP ethylene inhibitor and other chemicals together, and I increased the vase-lifetime of the flowers by more than 3 days.

2. I announced data for the positive effect of the benzyl-adenine in the interest of the increase of the lifetime and the ornamental value of the flowers in Hungary firstly.

3. The positive effect onto the lifetime of the flowers was better in the solutions that I created compared to the Spring and the Chrysal commercial preservatives.

4. I defined a method to determine the objective state of the leaves and the flowers.

5. I worked out the "ornamental value" of cut flowers, which incorporates more measurement results in a formula. This formula is suitable for valuation of the sate of every cut flower.

6. I employed the SPAD value for the fast estimate of the chlorophyll content of the leaves in the case of cut flowers; which measurement method proved that is more correct and real procedure than the chlorophyll measurement with the acetone (more expensive and lengthier) examination in the case of cut flowers leaves in Hungary firstly.

7. In the case of the sugar uptake of the carnation flowers I established that the plant take up the sucrose, but it can be manifested only in the stem, his quantity is negligible in the flower petals and the glucose concentration is higher than the fructose.

5. CONCLUSIONS AND SUGGESTIONS

In the case of the experiment with carnation ‘Gioko’ I found a positive context between the vase-lifetime of the flowers and the applied sugar concentrations. The 30 gL^{-1} and the taller sucrose concentration increased the vase-life by 1-3 days compared to the distilled water, but decreased significantly the lifetime with 2-5.5 days compared to the 0 and the 10 gL^{-1} sucrose concentrations. The added sucrose influenced positively the diameter of the flowers in the case of all concentration. The 10-30 gL^{-1} sucrose concentrations increased the diameter of the flowers more than 1 cm. The use of the 30 gL^{-1} and the taller sucrose concentration is unnecessary, and not suggested, because with the application of smaller concentration better result can be reached. The optimal sucrose concentration is the 10 and 20 gL^{-1} in the case of the carnation ‘Gioko’.

In the course of the experiment verifiable that the plant not only takes up the added sucrose from outside, but transform it into glucose and fructose in the stem. Hassan found (2005) in his PhD dissertation in the case of carnation ‘Asso’, that the concentration of fructose was the highest in the stem and in the petal too. Compared to my result with carnation ‘Gioko’, I measured a very low concentration of the fructose in the stem. I found higher concentration of fructose in the petals, but this was not significant, or was low compared to the glucose concentration.

The context of the number of the bacterium germ and the vase lifetime I managed to similar inferences than Van Doorn et al. (1991), who experienced that in the case of carnations in the 5 cm parts of under part of the stems the conductivity was decreased, and the number of bacteria was increased with the passing of 7 days. The prevention of the accumulation of the bacteria was prevent with various chemicals hereby the lifetime of the flowers did not increase. The 10^7 bacterium numbers (per millilitre) did not influence significantly the ageing of the flowers, so they had the conclusions, that the bacteria block the vascular tissues, but this has a hardly effect on the vase lifetime of the flowers. In the case of another experiment (Van Doorn et al., 1994) the carnations were put in the solutions of various bacterium concentrations, and it was experienced, that the 10^8 or a taller bacterium numbers (per millilitre) reduced the vase-life. The quantity of the bacteria did not attain the level that would influence harmfully the lifetime of the flowers neither in the flower shops, nor in the households under natural circumstances. The 2 mlL^{-1} Clorox reduced significantly the content of bacterium, but this did not influence significantly the vase lifetime during the experiment with carnation ‘Gioko’. The bacterium number reached the 10^8 values per millilitre alone in the Spring preservative solution, but I measured one of the highest lifetime in the case of Spring, which preservative increased the vase-life of the flowers by 9 days compare to distilled water.

The bacterium number was higher in the case of 1-MCP treatments, but this did not have an effect on the lifetime of the flowers.

Since Sisler et al. (1996) published first their results with 1-MCP about the antagonist's effect of the ethylene, the blocking role of the ethylene of the 1-MCP proved to be effective in the case of various cut flowers. The pretreatments, which ones made with 1-MCP increased the vase-life by a few days according to Sisler and Serek (2001). Hassan and Gerzson (2002), and Hassan et al. (2004) examined the effect of 1-MCP in different concentrations, and it was found that the 0.5 gm^{-3} for 6 hours treatment was the most effective to increase the vase-life of the flowers. According to Hassan and Gerzson (2002) the vase lifetime increased from 7.3 to 12.3 days due to the 1-MCP treatment compared to the control in the case of the white colour carnation 'Asso'. In my experiment I achieved 10 days increases with the same treatment compared to the control in the case of white colour carnation 'Gioko'. Furthermore the 1-MCP treatment proved to be better than Spring preservative, which used universally.

With the use of the Clorox effected the increase of the vase lifetime, and the postharvest quality of the flowers positively in the case of *carnation* '***Reina'***. Mostly the dosage of 1.5 and 2 mlL^{-1} Clorox is proposed, whit which one the lifetime of the flowers is extendible with 4-5 days. The dosage of the sugar not suggested in the case of this carnation, because it did not influence or decreased the vase-lifetime of the flowers.

The vase-life of carnation flowers 'Reina' was extendible with the application of the salicylic acid: the life of the flowers was increasable averagely with 2.4 days with the using of 125 mgL^{-1} salicylic acid solution compared to the distilled water, and the flowers had suitable size and their ornamental value was kept until longer time. I achieved a better result with the using of the salicylic acid than the application of the Clorox, and the Spring and the Floralife preservatives which can be buy in the trade in the case of carnation 'Reina'. The 500 mgL^{-1} salicylic acid concentration was too high in the case of 'Reina'.

I proved that the flowers in the solutions without antibacterial chemicals damaged soon due to the bacteria which proliferated in the vase solution in the case of the *rose* '***Happy Hour'***. The application of Spring preservative and the Clorox + 20 gL^{-1} sucrose solution were proposed, which had a favourable effect on the diameter and the lifetime of the flowers. The lifetime of the flowers is increasable averagely with 3 days. I measured most similar values in the case of the different period 1-MCP treatments, because I was not able to prove the unambiguous effect of the time and the temperature.

In the case of the experiment with *rose* '***Bordeaux'*** verifiable, that the application of the Spring preservative and the 1-MCP treatment has a positive effect not only on the vase lifetime, but the flowers keep their good quality as well. The usage of the Spring and the 1-MCP together increased the vase-life of the flowers by 3 days averagely. The examination of the dosage of the sucrose demands additional experiments anyway. The flowers, which had 18 hours 1-MCP treatment, were

better compared to the control and the 6 hours treatment in the case of the flower diameter, the vase-life (averagely 1-1.5 days of increases) and the ornamental value both of the Hungarian flowers, and which arrived from the foreign countries. This similar to the results of Cuquel et al. (2007), who found, that the 18 hours 1-MCP treatment was better than 6 hours in the case of rose 'Saphir' and 'Confetti'. This treatment recommended in the commercial chain primarily for the wholesalers, for example: we do this treatment on the way in the truck, that was loaded in Netherlands, then what the truck gets onto Hungary, the flowers are ready for the selling. Because of the favourable effect of this treatment is extendible the selling period, and the loss irreducible.

With the application of the commercial preservatives significantly increasable the water intake, since I measured double-quadruple values compared to the distilled water in the case of *rose* '***Red Paris'***. This experiment supports the results of the experiment with Chrysal (Chrysal review, 1993): the water intake doubled almost in the case of the rose 'Sonia' and 'Darling'.

The leaves of the plants preserved longer time their green colour and good state due to the preservatives. In the case of the examination of the chlorophyll content of the leaves I had to do the sampling with a bigger quantity of the leaves due to the smaller weight of the withered leaves, which measurement produced higher chlorophyll content. Due to this I measured the highest chlorophyll contents in the case of the tapwater. But this data was wrong, since the leaves damaged soon in the tapwater. Like this the SPAD measurement is proposed instead of the examination of the chlorophyll content, which reflects the state correct. For the good result it is suitable for sampling at the least 50 samplings per vase.

The *rose* '***La Belle'*** showed similar tendency, than 'Red Paris'. In both cases can be related, that the salicylic acid had not show the expected result with neither 50 mgL^{-1}, nor 100 mgL^{-1} concentration. The application of the commercial preservatives was proposed, since these chemicals increased the vase lifetime of the flowers with one and half, and double. The lifetime increased with 5.3 days in the case of the Chrysal, with 7.8 days in the case of Spring, and with 9.1 days in the case of Floralife compared to the distilled water. Not only the vase lifetime is increasable due to the preservatives, but they influenced positively the things, which are important for the ornamental values of the flowers.

I was not able to prove an unambiguous difference among the pH values of the solution with the benzyl-adenine in the case of the *rose **'Milonga'***. The Chrysal* solution, which was compiled by me (according to Nagy, 1982 and Wenszky, 1993) was not suitable for the increase of the lifetime of the flowers. The application of the Clorox and the 20 gL^{-1} sucrose affected advantageously the flower diameter, the ornamental value and the vase lifetime, since these chemicals extended the life of the flowers by 3.2 days compared to the distilled water. The higher lifetime (with 4 days) was achieve with the use of the benzyl-adenine in 8 mgL^{-1} concentrations, since this chemical effected advantageously the flowers, because with this the flowers kept their ornamental value longer (it increased with 1.1 and 2.5 days) compared to the Chrysal and the Spring commercial preservatives. I

suggest the application of the Floralife preservative, which increased the lifetime of the flowers with a week in the case of the rose 'Milonga'.

The commercial preservative solutions with 1-MCP treatment leaded to smaller state decay in the case of the *rose* '***Mariyo'***. Among the solutions, which ones I compiled the best result was received in the case of Clorox + 20 gL^{-1} sucrose with 1-MCP treatment, which proved to be much better, than the preservatives which can be buy in the trade. This treatment increased the vase lifetime of the flowers averagely with 12.2 days compared to the distilled water and with 6.4 days compared to the Chrysal, with 4.1 days compared to the Spring, and with 2.1 days compared to the Floralife. The proposed concentration of the benzyl-adenine is 1 and 2 mgL^{-1}, with which one the lifetime can be increased with 11.7 and 10.9 days compared to the distilled water.

In generality it can be concluded, that the flowers size was smaller in the case of the distilled water compared to the other solutions. The 1-MCP, and the benzyl-adenine treatments had not an effect to the pH. The sucrose, which was applied to the solutions, had a positive affect primarily for the diameter of the flowers; the 20 gL^{-1} concentration is proposed, in the case of the carnation and the rose flowers too. The accumulation of the bacteria is reducible with the application of the Clorox, but this not increases the vase lifetime in all cases, but his deficiency reduces it anyway.

The using of the 1-MCP has a favourable effect on the preservation of the good state of the leaves and the flowers, and extended the lifetime of the flowers. The combination of the chemicals is effective in most cases. The vase-life of the flowers increased with the application of the Spring, and the Clorox solution combined with 1-MCP treatment. I did not find an example among the literary data for the combined application of these chemicals, and hereby the increase of the lifetime of the flowers.

At the final conclusion is the effect of the commercial preservatives and the complied solutions depends on the species and varieties, but the application and combination of these treatments is proposed for the bigger flower diameter, the better decorator value and the longer vase life.

LIST OF PUBLICATIONS RELATED TO THE SUBJECT OF DISSERTATION

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