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KEEPING QUALITY OF CUT FLOWERS

As Influenced by Antibiotics And Various Other Agents

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Contents

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This bulletin reports results of a study to determine the effectiveness of various antibiotics, chemicals, commercial preservatives and other agents in extending the life of cut flowers. Experiments were initiated in 1959 at the Oklahoma Agricultural Experiment Station.

Review of Literature

Since the early 1900's many studies have been conducted to determine the effectiveness of various chemicals in extending the useful life of cut flowers. Among the first was a study published in 1906 by Fourten and Ducomet (3) which indicated that potassium hydroxide, calcium hydroxide, potassium chloride, and sucrose were effective in prolonging the life of certain species of cut flowers. Since that time a number of reports regarding the effectiveness of certain chemicals such as boric acid, silver nitrate, copper wire, various fungicides, chelating agents, and growth inhibitors have been published (2, 4, 5, 6, 7, 8). Several commercial preservatives such as Floralife[1] and Petalife,[1] which usually contain a pH buffer, a sugar, and a disinfectant, have been developed to prolong the useful life of cut flowers.

Various environmental treatments have also been reported to be effective in prolonging the life of cut flowers. These include hardening of the plants by reducing the application of water shortly before harvest and hardening of the cut flowers by storing them for several hours at low temperatures (4, 12).

In recent years several reports have indicated that concentrations of 50 ppm or more of certain antibiotics were inhibitory to plant growth (1, 9, 10, 11). It was thought that certain of the antibiotics might be effective in extending the life of cut flowers, due both to their senescence inhibition on plant growth and to their effectiveness in retarding the growth of fungus and bacteria organisms.

Research reported herein was conducted under Oklahoma Station Project Number 1082.

[1]Floralife is manufactured by Floralife, Inc., Chicago, Illinois; and Petalife by Ampco Chemicals Division, Broomfield, Colorado.

Materials and Methods

The four species used in these studies, *Antirrhinum majus* (snapdragon), *Dianthus caryophyllus* (carnation), *Chrysanthemum morifolium* (chrysanthemum), and *Callistephus chinensis* (China aster), were grown in greenhouses. Uniform flowering spikes were selected and placed in quart milk bottles, one, two, or three spikes per bottle, which contained various chemical solutions. In some tests, the foliage below the water line was completely removed, while in others it was not. Distilled water was used as the solvent in all tests unless otherwise stated. There were three replications in a randomized block design. The bottles were placed in a well-lighted, north-facing laboratory room with the temperature maintained at a minimum of 70° ± 3° F. The fluorescent lights in the room remained on 24 hours per day. The stems were not recut or removed from the solutions during the course of the experiment.

The useful life of each flower was determined to be the time the spikes were no longer desirable, *e.g.*, petals wilted, oldest ten florets on the snapdragons wilted or dropped, or spike collapsed.

The various chemicals, antibiotics, etc. used in these tests are listed in Table 1.

Table 1.—List of chemicals used in the various tests reported in these studies.[1]

Distilled Water	Tween "20"
Tap Water	Ilotycin
Floralife	Acrizane Chloride
Elcide "73"	Erythromycin
Boric Acid	Spontin
Sucrose	Viridogrisein
Maleic Hydrazide	Griseoviridin
Aspirin	Actinobolin Sulfate
Vancomycin Hydrochloride	Phosfon-D
Terramycin Hydrochloride	Wilt-Pruf
Neomycin Sulfate	Hydrazine Sulfate
Streptomycin Sulfate	Potassium Aluminum Sulfate
Hygromycin "B"	Naringenin
Saccharin	Naringin
Penicillin	Gibberellic Acid

[1]Acknowledgement is due to the following companies who contributed various chemicals and antibiotics used in these experiments:

Sunkist Growers, Ontario, California
Parke, Davis and Co., Detroit 32, Michigan
Chas. Pfizer and Co., Inc. Brooklyn 6, New York
Naugatuck Chemical Co., Div. of U. S. Rubber Co., Bethany 15, Conn.
Merck, Sharpe and Dohme, Merck and Co., Inc., West Point, Penn.
Abbott Laboratories, North Chicago, Ill.
Floralife Inc., Chicago 5, Illinois
Eli Lilly and Co., Greenfield, Indiana

Results

Snapdragon Test No. 1

The effect of tap water, Floralife, Elcide "73", and a boric acid and sucrose combination on the cut flower life of two varieties of snapdragons, Rockwood Crystal White and Rockwood Pink, with and without foliage below the water line removed, is shown in Table 2. Floralife significantly extended the life of cut snapdragons both with and without the foliage removed. There appeared to be no advantage to removing the foliage except in the case of the boric acid and sucrose combination treatment. The 100 ppm Elcide "73" and the boric acid and sucrose combination treatments significantly reduced cut flower life over that obtained in tap water. Little or no difference in length of life between varieties was evident.

Table 2.—Effect of Floralife, Elcide "73", and a boric acid and sucrose combination treatment on the cut life of two varieties of *Antirrhinum majus* (snapdragon).[1]

Treatment	**Average Life in Days**		
	Rockwood Crystal White ***(1 stem/treat.)***	**Rockwood Pink** ***(2 stems/treat.)***	**Avg.**
Basal Foliage On			
Tap Water (control)	5.3	5.3	5.3
Floralife (1 tbsp/qt)	8.0	8.7	8.4
Elcide "73" (10 ppm)	6.0	5.0	5.5
Elcide "73" (100 ppm)	1.0	1.0	1.0
Boric Acid (0.1%) + Sucrose (2%)	2.7	2.3	2.5
Average	**4.6**	**4.5**	
Basal Foliage Removed			
Tap Water (control)	5.7	5.0	5.4
Floralife (1 tbsp/qt)	9.0	9.0	9.0
Elcide "73" (10 ppm)	4.7	5.3	5.0
Elcide "73" (100 ppm)	1.0	1.0	1.0
Boric Acid (0.1%) + Sucrose (2%)	1.0	1.0	1.0
Average	**4.3**	**4.3**	

ANALYSIS OF VARIANCE[2]

Source	**d.f.**	**MS**
Variety	1	.07
Treatment	9	52.16**
Var x Treat	9	.40
Error	38	.35

**Significant at 1% level. L.S.D. for treatments at 1% level = 0.9; at 5% level = 0.7.

[1]Test was started 6/16/59. Each figure is an average of 3 replications.

[2]Courtesy R. D. Morrison, Statistical Laboratory, Oklahoma State University.

Table 3.—Effect of Floralife, Elcide "73", Maleic Hydrazide, aspirin, sucrose, and boric acid on the cut life of two varieties of *Antirrhinum majus* (snapdragon).[1]

Treatment	Average Life in Days		
	Rockwood Crystal White *(1 stem/treat.)*	Rockwood Summer Yellow *(1 stem/treat.)*	Avg.
Tap Water (control)	6.3	6.0	6.2
Floralife (1 tbsp/qt)	7.3	8.0	7.7
Elcide "73" (1 ppm)	7.0	6.3	6.7
" " (10 ppm)	5.7	6.0	5.9
Maleic Hydrazide (50 ppm)	6.3	6.0	6.2
" " (100 ppm)	6.7	6.0	6.4
" " (500 ppm)	7.0	6.3	6.7
" " (1000 ppm)	5.3	6.0	5.7
Aspirin (5 grains/qt)	3.7	3.7	3.7
" (10 grains/qt)	3.0	2.3	2.7
" (20 grains/qt)	3.0	2.3	2.7
Sucrose (1%)	6.7	6.7	6.7
" (2%)	7.3	7.0	7.2
" (4%)	8.0	7.7	7.9
Boric Acid (0.1%)	5.7	4.7	5.2
" " (0.2%)	4.3	4.0	4.2
Average	**5.8**	**5.6**	

ANALYSIS OF VARIANCE[2]

Source	d.f.	MS
Variety	1	.51
Treatment	15	15.63**
Var x Treat	15	.31
Error	62	.61

**Significant at the 1% level. L.S.D. for treatments at the 1% level = 1.2; at the 5% level = 0.9.
[1]Test was started 6/22/59. Each figure is an average of 3 replications. All foliage below the water line was removed.
[2]Refer to footnote 2, Table 2.

Snapdragon Test No. 2

Table 3 shows the effect of tap water and varying concentrations of Floralife, Elcide "73", Maleic Hydrazide, aspirin, sucrose, and boric acid on the life of two varieties of snapdragons, Rockwood Crystal White and Rockwood Summer Yellow, with all foliage below the water line removed. The Floralife and four percent sucrose treatments were significantly better than the tap water solution. However, the tap water was significantly better than any of the aspirin treatments or the 0.2 percent boric acid treatment. There were no significant differences between varieties.

Snapdragon Test No. 3

The effect of tap water, Floralife, and 10 and 100 ppm of five antibiotics, Vancomycin Hydrochloride, Terramycin Hydrochloride, Neomycin Sulfate, Streptomycin Sulfate, and Hygromycin "B" on the life of three varieties of snapdragons, Rockwood Crystal White, Rockwood Summer Yellow, and Rockwood Summer Pink, with all foliage below the water line removed, is shown in Table 4. The Floralife treatment was significantly better than all other treatments. The tap water treatment was significantly better than the 100 ppm Hygromycin "B" treatment. Over all treatments, Rockwood Crystal White variety lasted significantly longer than either Rockwood Summer Yellow or Rockwood Summer Pink.

Table 4.—Effect of Floralife and five antibiotics on the cut life of three varieties of *Antirrhinum majus* (snapdragon).[1]

Treatment	**Average Life in Days**			
	Rockwood Crystal White *(1 stem /treat.)*	**Rockwood Summer Yellow** *(1 stem /treat.)*	**Rockwood Summer Pink** *(1 stem /treat.)*	**Avg.**
Tap Water (control)	6.7	5.7	5.3	5.9
Floralife (1 tbsp/qt)	8.3	9.0	7.7	8.3
Vancomycin Hydrochloride (10 ppm)	6.7	5.3	5.3	5.8
〃 〃 (100 ppm)	6.0	5.3	5.0	5.4
Terramycin Hydrochloride (10 ppm)	6.7	5.7	5.7	6.0
〃 〃 (100 ppm)	5.7	6.0	6.0	5.9
Neomycin Sulfate (10 ppm)	6.7	6.0	6.0	6.2
〃 〃 (100 ppm)	6.7	5.7	5.3	5.9
Streptomycin Sulfate (10 ppm)	6.7	5.3	5.7	5.9
〃 〃 (100 ppm)	7.0	5.7	5.3	6.0
Hygromycin "B" (10 ppm)	5.0	6.0	4.3	5.1
〃 〃 (100 ppm)	4.7	4.7	5.0	4.8
Average	**6.4**	**5.9**	**5.6**	

ANALYSIS OF VARIANCE[2]

Source	**d.f.**	**MS**
Variety	2	5.90**
Treatment	11	6.66**
Var x Treat	22	.71
Error	70	.39

**Significant at the 1% level. L.S.D. at the 1% level for variety = 0.4; for treatment = 0.8. L.S D. at 5% level for variety = 0.3; for treatment = 0.6.

[1]Test was started 7/1/59. Each figure is an average of 3 replications. All foliage below the water line was removed.

[2]Refer to footnote 2, Table 2.

Snapdragon Test No. 4

Table 5 shows the effects of tap water, distilled water, Floralife, saccharin, Tween "20", and five antibiotics, Penicillin, Ilotycin, Acrizane Chloride, Erythromycin, and Spontin, on the cut life of Rockwood Crystal White snapdragons, with all foliage below the water line removed. Floralife significantly extended the cut flower life over the tap water and distilled water treatments. Acrizane Chloride, at a concentration of 100 ppm, also significantly extended the life of cut flowers over that of tap water. Both the tap water and distilled water treatments were significantly better than the saccharin or the Tween "20" treatments. There were no significant differences between tap water and distilled water treatments or between any of the other antibiotic treatments.

Table 5.—Effect of Floralife, saccharin, Tween "20", and five antibiotics on the cut life of *Antirrhinum majus* (snapdragon), var. Rockwood Crystal White.[1]

Treatment	**Average Life in Days** ***(1 stem/treat.)***
Tap Water (control)	5.0
Distilled Water (control)	6.0
Floralife (½ tbsp/qt)	9.0
" (1 tbsp/qt)	9.0
Saccharin (1%)	1.0
" (2%)	1.0
Tween "20" (5 cc/qt)	2.3
" " (10 cc/qt)	1.7
Penicillin (10 ppm)	6.3
" (100 ppm)	5.0
Ilotycin (10 ppm)	5.0
" (100 ppm)	5.0
Acrizane Chloride (10 ppm)	5.7
" " (100 ppm)	7.7
Erythromycin (10 ppm)	5.0
" (100 ppm)	6.3
Spontin (10 ppm)	6.3
" (100 ppm)	6.3

ANALYSIS OF VARIANCE[2]

Source	**d.f.**	**MS**
Treatment	19	15.54**
Error	38	2.52

**Significant at the 1% level. L.S.D. for Treatments at the 1% level = 3.5; at the 5% level = 2.6.

[1]Test was started 8/1/59. Each figure is an average of 3 replications. All foliage below the water line was removed.

[2]Refer to footnote 2, Table 2.

Table 6.—Effect of Floralife, aspirin, and Wilt-Pruf combination spray and dip treatments on the cut life of three varieties of *Antirrhinum majus* (snapdragon).[1]

Treatment	Average Life in Days			
	Doubloon *(1 stem /treat.)*	Treasure Chest *(1 stem /treat.)*	Snowman *(1 stem /treat.)*	Avg.
Tap Water (control)	8.0	8.0	11.0	9.0
Floralife (1 tbsp/qt)	7.0	9.5	12.5	9.7
Aspirin (5 grains/qt)	4.0	7.0	4.5	5.2
Tap Water (blooms dipped in tap water)	9.5	8.0	10.0	9.2
Tap Water (blooms sprayed with 1:10 Wilt-Pruf)	9.5	9.5	9.5	9.5
Tap Water (blooms sprayed with 1:100 Wilt-Pruf)	9.0	7.0	13.0	9.3
Tap Water (blooms dipped in 1:5 Wilt-Pruf and rinsed)	8.0	8.5	11.0	9.2
Tap Water (blooms dipped in 1:10 Wilt-Pruf and rinsed)	8.0	7.5	12.0	9.2
Tap Water (blooms dipped in 1:100 Wilt-Pruf and rinsed)	9.0	8.5	11.0	9.5
Floralife (1 tbsp/qt)—(blooms sprayed with 1:10 Wilt-Pruf)	8.0	7.0	13.0	9.3
Average	**8.0**	**8.1**	**10.7**	

ANALYSIS OF VARIANCE[2]

Source	d.f.	MS
Variety	2	46.87**
Treatment	9	10.82**
Var x Treat	18	4.03
Error	29	2.37

**Significant at the 1% level. L.S.D. at the 1% level for variety = 1.4; for treatment = 2.5. L.S.D. at the 5% level for variety = 1.0; for treatment = 1.8.

[1]Test was started 11/20/59. Each figure is an average of 2 replications. All foliage below the water line was removed.

[2]Refer to footnote 2, Table 2.

Snapdragon Test No. 5

The effect of tap water, Floralife, aspirin, and Wilt-Pruf combination spray and dip treatments on the cut flower life of three varieties of snapdragons, Doubloon, Treasure Chest, and Snowman, is shown in Table 6. None of the treatments were significantly better than the tap water treatment; however, the tap water treatment was significantly better than the aspirin treatment. Snowman variety lasted significantly longer than either Doubloon or Treasure Chest varieties.

Snapdragon Test No. 6

The effect of tap water, Floralife, Hydrazine Sulfate, potassium aluminum sulfate, Naringenin, saccharin, sucrose, and Tween "20" on the cut flower life of Colorado variety snapdragon, with all foliage below the water line removed, is shown in Table 7. Naringenin treatments, at concentrations of 10, 100, and 1000 ppm, were significantly better than the tap water treatment. The tap water treatment, however, was significantly better than all the other treatments except the 1 ppm Naringenin treatment.

Snapdragon Test No. 7

Table 8 shows the effects of tap water, distilled water, Floralife, aspirin, and various concentrations of Gibberellic Acid sprays and solutions on the cut flower life of Colorado snapdragons, with all foliage below the water line removed. The Floralife treatment was significantly better than either the tap water or distilled water treatments. However, the tap water and distilled water treatments were significantly better

Table 7.—Effect of Floralife, Hydrazine Sulfate,[1] potassium aluminum sulfate,[1] Naringenin,[2] saccharin, sucrose, and Tween "20" on the cut life of *Antirrhinum majus* (snapdragon), var. Colorado.[3]

Treatment	**Average Life in Days** *(3 stems/treat.)*
Tap Water (control)	8.0
Floralife (1 tbsp/qt)	5.7
Hydrazine Sulfate	2.7
Potassium aluminum sulfate	2.0
Naringenin (1 ppm)	8.3
" (10 ppm)	9.0
" (100 ppm)	9.0
" (1000 ppm)	8.7
Saccharin (2 gm/qt)	3.3
Sucrose (2 gm/qt)	6.7
Tween "20" (1 cc/qt)	2.3
" " (2 cc/qt)	2.0

ANALYSIS OF VARIANCE[4]

Source	**d.f.**	**MS**
Treat	11	26.51**
Error	22	.47

**Significant at the 1% level. L.S.D. for treatments at the 1% level = 0.5; at the 5% level = 0.4.

[1]Formula according to Laurie, A , D. C. Kiplinger, and K. S. Nelson. *Commercial Flower Forcing.* p. 486.

[2]Four grams dissolved in 50 ml of 95% ethyl alcohol before dilution to proper concentration.

[3]Test was started 11/8/60. Each figure is an average of 3 replications. All foliage below the water line was removed.

[4]Refer to footnote 2, Table 2.

Table 8.—Effect of Floralife, aspirin, and various concentrations of Gibberellic Acid sprays and solutions on the cut life of *Antirrhinum majus* (snapdragon), var. Colorado.[1]

Treatment	Average Life in Days (*3 stems/treat.*)
Tap Water (control)	7.7
Distilled Water (control)	8.3
Floralife (1 tbsp/qt)	15.0
Aspirin (5 grains/qt)	3.3
Gibberellic Acid (1 ppm)—sprayed on leaves	10.0
" " (10 ppm)— " " "	9.3
" " (100 ppm)— " " "	8.0
" " (1000 ppm)—" " "	8.3
" " (1 ppm)—solution	9.7
" " (10 ppm)— "	11.3
" " (100 ppm)— "	8.0
" " (1000 ppm)— "	4.3

ANALYSIS OF VARIANCE[2]

Source	d.f.	MS
Treatment	11	28.86**
Error	22	3.50

**Significant at the 1% level. L.S.D. for treatment at the 1% level = 4.2; at the 5% level = 3.1.

[1]Test was started 3/30/61. Each figure is an average of 3 replications. All foliage below the water line was removed.

[2]Refer to footnote 2, Table 2.

than the aspirin treatment and the 1000 ppm Gibberellic Acid treatments. It was noted that increasing concentrations of Gibberellic Acid solution had a deleterious effect on the cut flower life of snapdragons, but that increasing concentrations of a Gibberellic Acid spray apparently had no such effect.

Carnation Test No. 1

The effect of tap water, Floralife, Elcide "73", and a boric acid and sucrose combination treatment on the cut flower life of two varieties of carnations, Red Sim and White Sim, is shown in Table 9. The Floralife treatment was significantly better than the tap water treatment, both with and without foliage below the water line removed. The boric acid and sucrose combination treatment was significantly better than the tap water treatment, either with or without foliage below the water line removed. There were no significant differences between varieties and no apparent difference between the foliage removal treatments.

Table 9.—Effect of Floralife, Elcide "73", and a boric acid and sucrose combination treatment on the cut life of two varieties of *Dianthus caryophyllus* (carnation).[1]

Treatment	Average Life in Days		
	Red Sim *(2 stems/ treat.)*	**White Sim** *(2 stems/ treat.)*	**Avg.**
Basal Foliage On			
Tap water (control)	6.0	5.3	5.7
Floralife (1 tbsp/qt)	9.3	7.7	8.5
Elcide "73" (10 ppm)	7.0	6.3	6.7
" " (100 ppm)	4.3	5.3	4.8
Boric acid (0.1%) + sucrose (2%)	9.3	6.3	7.8
Average	**7.2**	**6.2**	
Basal Foliage Removed			
Tap water (control)	4.7	5.7	5.2
Floralife (1 tbsp/qt)	8.3	9.0	8.7
Elcide "73" (10 ppm)	5.0	6.0	5.5
" " (100 ppm)	4.0	4.0	4.0
Boric acd (0.1%) + sucrose (2%)	8.0	6.3	7.2
Average	**6.0**	**6.2**	

ANALYSIS OF VARIANCE[2]

Source	**d.f.**	**MS**
Variety	1	2.01
Treatment	9	16.08**
Var x Treat	9	3.02
Error	38	2.49

**Significant at the 1% level. L.S.D. for treatments at the 1% level = 2.5; at the 5% level = 1.8.
[1]Test was started 6/19/59. Each figure is an average of 3 replications.
[2]Refer to footnote 2, Table 2.

Chrysanthemum Test No. 1

Table 10 shows the effect of tap water, Floralife, sucrose, aspirin, Phosfon-D, and seven antibiotics, Viridogrisein, Griseoviridin, Actinobolin Sulfate, Penicillin, Terramycin Hydrochloride, Neomycin Sulfate, and Streptomycin Sulfate, on the cut flower life of two varieties of standard chrysanthemums, Indianapolis Yellow and Indianapolis Pink. Tap water treated plants lasted significantly longer than any of the sucrose, aspirin, or Phosfon-D treatments. The flowers in the tap water treatment also lasted significantly longer than the 10 ppm Viridogrisein, Streptomycin Sulfate, and Griseoviridin treatments, and the 100 ppm Viridogrisein treatment. There was no significant difference between the tap water treatment and the Floralife treatment or any of the other antibiotic treatments.

Table 10.—Effect of Floralife, sucrose, aspirin, Phosfon-D, and seven antibiotics on the cut life of two varieties of *Chrysanthemum morifolium* (chrysanthemum).[1]

Treatment	Average Life in Days		
	Indianapolis Yellow *(1 stem/ treat.)*	Indianapolis Pink *(1 stem/ treat.)*	Avg.
Tap water (control)	22.5	23.0	22.8
Floralife (1 tbsp/qt)	21.0	21.5	21.3
Sucrose (1%)	12.5	9.0	10.8
" (2%)	14.0	12.0	13.0
Aspirin (5 grains/qt)	10.0	10.0	10.0
" (10 grains/qt)	9.5	6.0	7.8
Phosfon-D (1%)	9.0	8.5	8.8
" (2%)	6.0	6.0	6.0
Viridogrisein (10 ppm)	14.5	15.0	14.8
" (100 ppm)	17.5	16.5	17.0
Griseoviridin (10 ppm)	19.0	15.5	17.3
" (100 ppm)	21.0	19.0	20.0
Actinobolin Sulfate (10 ppm)	20.0	20.5	20.3
" " (100 ppm)	17.0	21.5	19.3
Penicillin (10 ppm)	21.5	22.0	21.8
" (100 ppm)	22.0	21.5	21.8
Terramycin Hydrochloride (10 ppm)	24.5	23.5	24.0
" " (100 ppm)	19.0	18.5	18.8
Neomycin Sulfate (10 ppm)	18.0	21.0	19.5
" " (100 ppm)	19.5	19.0	19.3
Streptomycin Sulfate (10 ppm)	18.0	15.5	16.8
" "	20.0	21.5	20.8

ANALYSIS OF VARIANCE[2]

Source	d.f.	MS
Variety	1	2.91
Treatment	21	111.28**
Var x Treat	21	3.74
Error	43	11.54

**Significant at the 1% level. L.S.D. for treatments at the 1% level = 6.5; at the 5% level = 4.9.
[1]Test was started 10/14/59. Each figure is an average of 2 replications. All foliage below the water line was removed.
[2]Refer to footnote 2, Table 2.

China Aster Test No. 1

Table 11 shows the effect of tap water, Floralife, Naringenin, Naringin, sucrose, aspirin, Elcide "73", Maleic Hydrazide and a sucrose-Naringenin combination on the cut flower life of China aster. The tap water treatment was significantly better than the Elcide "73" and the sucrose-Naringenin combination treatments. Flowers in the aspirin

Table 11.—Effect of Floralife, Naringenin, Naringin, sucrose, aspirin, Elcide "73", Maleic Hydrazide, and a sucrose Naringenin combination treatment on the cut life of *Callistephus chinensis* (China aster), var. Pink Ball.[1]

Treatment	Average Life in Days (2 stems/treat.)
Tap water (control)	10.0
Floralife (1 tbsp/qt)	9.0
Naringenin (10 ppm)	9.7
" (1000 ppm)	11.3
Naringin (10 ppm)	11.0
" (1000 ppm)	7.7
Sucrose (2%)	8.7
Aspirin (5 grains/qt)	5.3
Elcide "73" (0.1%)	3.3
Maleic Hydrazide (.1%)	8.0
" " (1.0%)	11.0
Sucrose (2%) + Naringenin (1000 ppm)	4.0

ANALYSIS OF VARIANCE[2]

Source	d.f.	MS
Treatment	11	23.17**
Error	22	6.31

**Significant at the 1% level. L.S.D. for treatment at the 1% level = 5.9; at the 5% level = 4.4.

[1]Test was started 2/1/61. Each figure is an average of 3 replications. All foliage below the water line was removed.

[2]Refer to footnote 2, Table 2.

treatment lasted significantly fewer days than the tap water treatment. None of the treatments were significantly better than the tap water treatment.

Discussion and Conclusions

Most of the antibiotics used in these studies had little or no effect, at the concentrations used, on the lasting time of cut snapdragons or chrysanthemums. Only in the case of the 10 and 100 ppm Viridogrisein and 10 ppm Griseoviridin and Streptomycin Sulfate treatments was there any significant reduction in lasting time over that of tap water. Apparently the antibiotics, at these concentrations, did little to inhibit the plugging of the xylem vessels in the stems by bacteria and fungus organisms; neither were they toxic to cut flowers.

Floralife, a commercial preservative, proved to be very satisfactory in the majority of the tests reported herein. It was observed that several of the materials, such as aspirin and boric acid, which had been reported in the literature to extend the cut flower life of certain species, instead, at low concentrations, drastically reduced the cut flower life of snapdragons, chrysanthemums, and China asters. Another substance with fungicidal properties, Elcide "73", also was toxic to cut flowers at concentrations in excess of 10 ppm.

One and two percent solutions of sucrose increased the cut flower life of several flowers in these experiments, although these solutions actually provide a very suitable medium for the development of bacteria and fungus growth. They also provide a ready reserve source of food which the flower uses in respiration, thus enabling the flowers to remain usable longer. Eventually, however, the xylem vessels become plugged and the uptake of water is stopped. There was no significant difference noted between distilled water and the tap water controls.

The ideal type of an additive to keep flowers fresh would be a combination material which contains (1) a food supply to provide a source of energy for respiration, and (2) some material or materials to inhibit fungus and bacteria development. None of these materials should be present in large enough quantities to be toxic to the flower, however. There are probably several combinations that would be satisfactory, such as commercial preservatives like Floralife or Petalife. However, variables in the pH of the water used, differences in response of various varieties and species, and environmental variations make it difficult to achieve desired results in every situation.

Summary

The effect of a number of antibiotics and several other materials with reported preservative properties, such as aspirin, boric acid, sucrose, etc., on the cut flower life of snapdragons, chrysanthemums, carnations, and China asters are reported. These materials were used in comparison with Floralife, which proved to be very satisfactory in extending the useful life of cut flowers in the majority of the tests reported. None of the antibiotics tested significantly extended the cut flower life of any species over that of the tap water treatment. Aspirin and weak boric acid solutions significantly decreased the cut flower life of all species. Elcide "73", a fungicide, also was toxic to flowers at concentrations above 10 ppm. Maleic Hydrazide had no apparent effect on the cut flower life. There was little difference between varieties or between species to the materials used in these tests.

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