

## 蔗糖在切花保鮮劑中之角色

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在保鮮劑中，加入蔗糖，能夠延長鮮花壽命為眾所週知之常識。對於蔗糖在保鮮劑中之角色及其對切花之影響的研究報告亦很多，本文謹就幾種花卉作物應用蔗糖保鮮劑之結果整理，得知在切花保鮮劑中加入蔗糖會：

- 1.增加切花之鮮重
- 2.增加切花之乾重
- 3.提高切花之品質（花徑較大、高）
- 4.提早開花
- 5.延長切花壽命
- 6.增加吸水量
- 7.使氣孔關閉
- 8.減少蒸散量

然而使用蔗糖亦會造成水中微生物之蔓延，所以下列因子會影響蔗糖之有效性：

1. pH
2. 8-HQ

保鮮劑中之蔗糖在植物體內由導管運輸，花為主要之吸收源，蔗糖會陸續集中於花，亦會有少部份橫向運輸至篩管。切花在貯藏中蔗糖為能源之來源，添加蔗糖，除可增加還原糖之供應外，對於胺基酸、有機酸、蛋白質等亦有增加，並可維持長時間呼吸作用之能源所需。蔗糖尚可抑制乙烯之生成，對切花之壽命有延長之效果。

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  11. Larsen, F. E. and M. Frolich 1969. The influence of 8-hydroxyquinoline citrate, N-dimethylamino succinamic acid, and sucrose on respiration and water flow in "Red Sim" cut carnations in relation to flower senescence. J. Amer. Soc. Hort. Sci. 94:289-292.
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  13. Mayak, S. and A. Borochoy 1984. Nonosmotic inhibition by sugar of the ethylene-forming activity associated with microsomal membranes from carnation petals. Plant Physiol. 76:191-195.
  14. Nichols, R. 1975. Senescence and sugar status of the cut flower. Acta Hort. 41:21-30.
  15. Paulin, A. 1986. Influence of exogenous sugar on the evolution of some senescence parameters of petals. Acta Hort. 181:183-193.
  16. Sacalis, J. N. 1975. Sucrose: patterns of uptake and some effects on cut flower senescence. Acta Hort. 41:45-53.

Table 8. Ultimate flower size, leaf injury and water uptake of 'Fred Shoemith' as influenced by sucrose in bud opening. Cut buds opened in soil I were compared to flowers opened on intact plants in the laboratory and in the greenhouse. Stage 1 buds were used.<sup>z</sup>

Treatment	Final flower size after 13 days			Wilting & leaf damage rating <sup>y</sup>		Water uptake per stem (ml)
	Diam (cm)	Fresh wt (g)	Dry wt (g)	8 days	13 days	
No sucrose	9.7	14.162.52	1.3560.20	0	0	119.5
0.612% sucrose	11.6	24.164.35	1.8860.66	0	0	142
1.25% sucrose	11.3	28.762.07	2.5260.32	0	0	183.5
2.50% sucrose	12.5	40.664.94	3.7860.46	0	0.1	187
5.0% sucrose	13.6	46.264.68	5.4360.50	0.5	1.2	185
10.0% sucrose	8.7	22.762.80	4.1260.24	0.8	2.0	180.5
Lab. (10 lvs) potted plants	11.2	23.161.29	1.6460.1	0	0	232
Chse. (10 lvs) potted plants	12.9	27.261.67	1.8960.1	0	0	2
Chse. (10 lvs) potted plants	13.6	36.868.16	2.7960.53	0	0	2

<sup>z</sup> Diameters 4.2 cm; fresh wt 8.5 g; dry wt 0.92 g.

<sup>y</sup> Leaf wilting and damage; 0=none; 1=slight; 2=moderate; 3=severe.

Table 6. Influence of pH, 8-hydroxyquinoline citrate, and sucrose on solution absorption and fresh weight of cut 'Better Times' roses after 3 days. (Exp. 4)

Solution pH, 8-HQC and sucrose concentration	Solution <sup>w</sup> absorption	Fresh weight
pH	ml	% change
4	85.9 a <sup>y</sup>	10.5 a <sup>x</sup>
6	76.5 b	25.2 b
8-HQC		
0	75.7 b <sup>y</sup>	26.7 b <sup>y</sup>
200 ppm	86.7 a	12.0 a
Sucrose		
0	108.9 a <sup>y</sup>	25.6 b <sup>y</sup>
2%	56.3 b	10.9 a

<sup>w</sup> Each figure is the mean cumulative solution absorption of 12 pairs of roses for 3 days.

<sup>x</sup> Means in a treatment group followed by the same letter are not significantly different at the 5% level.

<sup>y</sup> Means in a treatment group followed by the same letter are not significantly different at the 1% level.

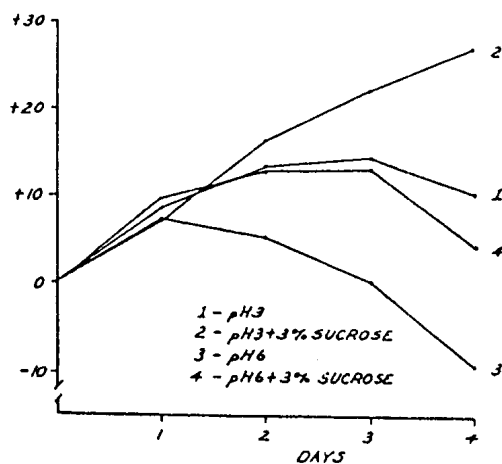


Fig. 1. Daily percent changes in fresh weight of cut 'Better Times' roses in solutions at pH 3 and 6, with and without sucrose (Exp. 3)

Table 3. Degree of leaf wilting of 'Albatross' with 3 sucrose conce and 3 light Intensitles.<sup>x</sup>

Sucrose conen (%)	Light intensity					
	Low		Moderate		High	
	1 day	7 days	1 day	7 days	1 day	7 days
1.5	0	0.3	0.1	1.0	0.2	2.6
3.0	0.2	0.3	1.3	1.7	1.2	3.0
4.5	1.2	0.6	1.5	2.4	2.0	3.0

<sup>x</sup> Leaf wilting was rated as 05none, 15slight, 25moderate and 35severe. Ratings were made 1 and 7 days after

treatments began. Buds opened in soln 1.

Table 4. Flower size and number of days to full opening of 'Albatroas' flower buds (4.5 cm diam).<sup>z</sup>

Sucrose concn (%)	Light intensity					
	Low		Moderate		High	
	Flower diam (cm)	Days to full fir size	Flower diam (cm)	Days to full fir size	Flower diam (cm)	Days to full fir size
1.5	11.46	10.0	11.86	7.5	9.86	7.0
3.0	11.56	10.0	10.36	8.1	7.86	2 <sup>y</sup>
4.5	12.86	7.7	10.16	7.0	7.06	2 <sup>y</sup>

<sup>z</sup> Buds were opened with 3 sucrose concentrations and 3 light intensities. Soln 1 was used.

<sup>y</sup> Flowers did not attain full size.

Table 2. Effect of various concn of sucrose and 8-HQC on development of 'May Shoesmtl' flowers (75 cm stems plus inflorescences).<sup>z</sup>

Sucrose (%)	8-HQC (ppm)	Original fresh wt (g) <sup>y</sup>	Final fresh wt (g) <sup>y</sup>	Dry wt (g)	Total soin uptake (ml)	Vase life (days)	
						After development bud-cut <sup>xw</sup>	Commercl harvest (approx 125 mm diam) <sup>w</sup>
0	0	236	245	59.7 a	783 ab	2	6
0	200	272	327	64.6 ab	1413 c	7	8
0	400	257	315	62.8 ab	960 b	4	6
2	0	229	250	66.4 ab	697 ab	1	3
2	200	249	452	95.0 cd	2838 e	13	14
2	400	216	360	72.2 b	1182 bc	4	6
4	0	231	286	72.7 b	613 a	1	3
4	200	206	426	104.0 d	1997 d	13	14
4	400	212	396	90.8 c	1375 c	7	8

<sup>z</sup> Mean separation within columns by HSD, 5% level.

<sup>y</sup> Large differences in fresh wt were observed; however, in the F-test analysis, the probability

<sup>F</sup> was 0.139 and 0.068, respectively.

<sup>x</sup> Addition of 6 days (mean time of development to commercial size) would approximate lot days vase life of bud-cut flowers.

<sup>w</sup> Means could not be separated due to removal of entire treatments at one time.

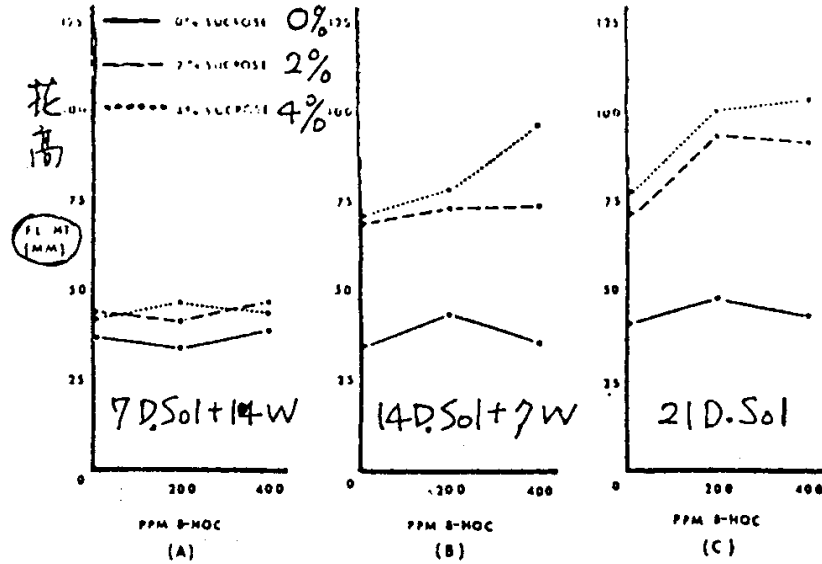


Fig. 1. Effect of sucrose concn, 8-HQC concn, and time in opening soin on flower ht 20 days after harvest of bud-cut 'Southern comfort' flowers. (A) Flowers held in opening soin 7 days followed by 14 days in deionized water. (B) Flowers held in opening soin 14 days followed by 7 days in deionized water. (C) Flowers held in opening soln 21 days.

Table 3. Influence of holding solution pll and sucrose on stomatal diameters of cut 'Better Times' coses after 3 days. (Exp. 3).

Solution pH	Sucrose Concentration		pll mean
	0	3%	
	microns		
3	4.6a <sup>x</sup>	1.1b	2.9a
4	5.0a	1.1b	3.0a
5	2.1b	0.9b	1.5b
6	1.5b	1.0b	1.3b
Sucrose mean	3.3a	1.0b	

<sup>x</sup> means in each box followed by the same letters are not signifly cantly different at the 1% level.

Table 1. Water potential of leaves and florets of chrysantinemons flowers (cv. Shoemith and Albatros), grown to full in greanhous or cut at the bud stage and opened for 8 days in solutions cutaining various concentrations of sugar. Potential was mensured in loaves and florets of fully open flowers (Halsvy and Mayak, 1974)

Z sugar in oel.	Water potential (bars)			
	Shoermith		Albatros	
	Florets	Leaves	Florets	Leaves
0	2 8.8	2 7.3	2 4.8	25.8
2.5	219.4	2 7.3	2 9.6	25.2
5.0	219.8	212.1	214.8	26.4
10.0	224.6	216.4	213.2	— *
20.0	225.2	219.2	222.0	— *
Full bloom in greenhose	2 8.8	2 7.1	2 5.2	25.6

\* Leaves desiccated.

Table 2. Longevity and water uptake (in the first 4 days in water) of White Sim carnations treated for 20 hours with 10% sucrose or with various concentrations of XC1. The base of all flowers was immersed for 10 min in 1000 ppm AgNO<sub>3</sub> prior to the sugar or KCl treatment. After treatment, flowers were held dry in cartons at 21°C for 28 hours and then placed in deionized water. Pretreatment and holding were done under constant conditions of 21°C and fluorescent (Cool White) illumination at 1000/lux.

Treatment	Longevity (days)	Water uptake (g/flower)
Control (water)	5.3 d	4.8 c
10.0% sucrose	10.1 a	12.2 a
0.5 % XC1	7.2 c	8.7 b
1.0% 0	9.1 b	11.8 a
1.5% 0	8.4 b	10.7 a

Values in each column followed by different letters are significantly different at the 5% level

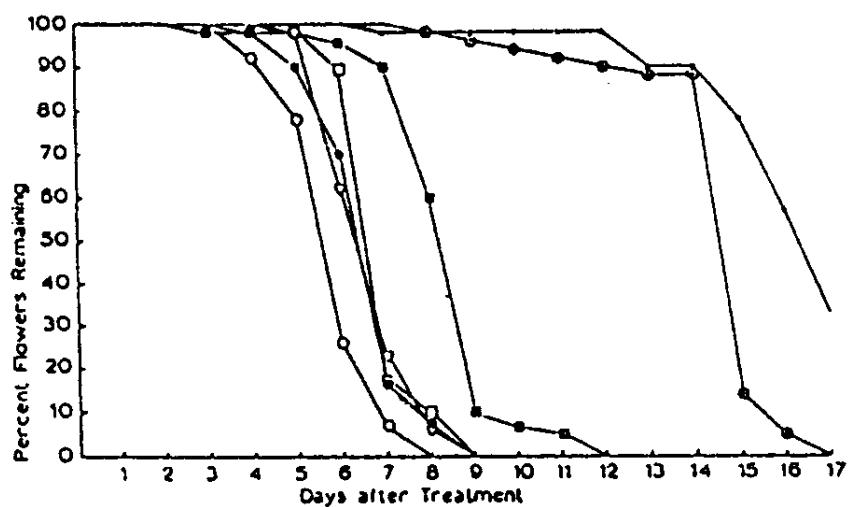


Fig 4. The effect of different rate solution on vase-life of 'Red Sim' cut carnation.

Table 1. Mean distribution of <sup>14</sup>C-sucrose from an aqueous vase solution through immature and mature cut *Proteaneriifolia* inflorescences from eight different plants after 18 hours

Plant tissue	Mean disintegrations per minute x10 <sup>3</sup> /g fresh mass	
	Immature inflorescences	Mature inflorescences
Leaves	6.51	8.52
Bracts	10.40	12.24
Ovaries	13.56	14.75
Stamens	2.64	3.36
	Standard error 50.586	Standard error 50.572

Table 5. The effect of conditioning of gladiolus flower (cv. Oscar) in solution containing no sugar or 20% sugar on water potential of petale. Flowers were conditioned for 20 hr, held in a carton at 22°C for 24 hr, then recut and placed in tap water. Potential was measured with a thermocouple psychrometer. (After Mayak, Bravdo, Gvilli and Halevy, 1972)

Time of measurement	Water potential (bars)	
	Wo sugar	20% sugar
Prior to conditioning	22.1	22.1
At the and of conditioning	21.4	24.0
After air transport aimulation	21.6	24.8
3 days in water	21.9	21.2

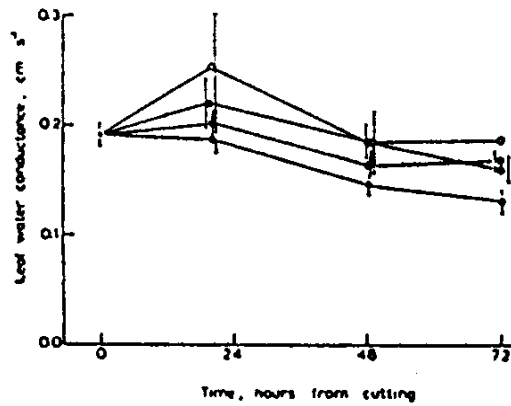


Fig. 4. effects of sucrose concentration on leaf conductance, stems cut at 14.10 GMT. Sucrose concentrations: 0%, ○:2%; ●:4%; ● and 6%, (all with 30 mg l<sup>-1</sup> silver nitrate) Cultivar 'Tuneful'.

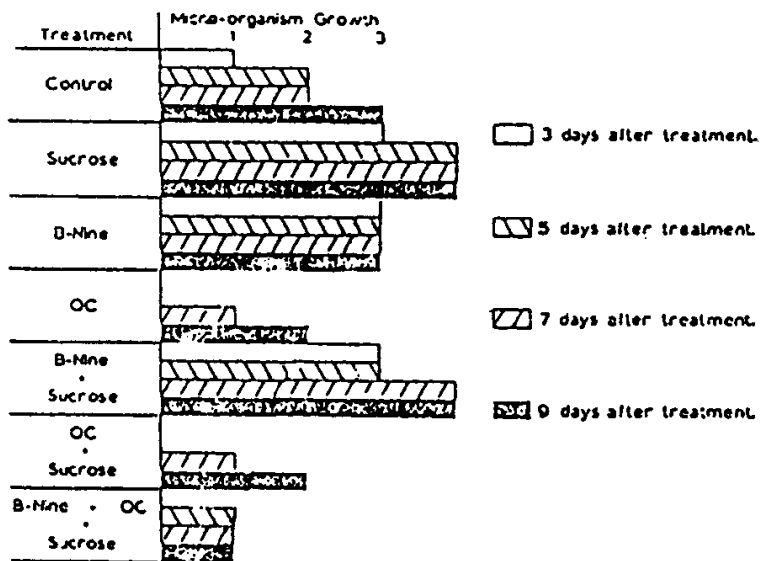


Fig. 5. Microscopic sinal rating of micin-organlmn growth on 4 cm hand cut head stem sections of 'Red Sim' rut carnations as allceted by different vase solutions %era Indicates no visible growth aml 4 indicares profure growth at the stem base.

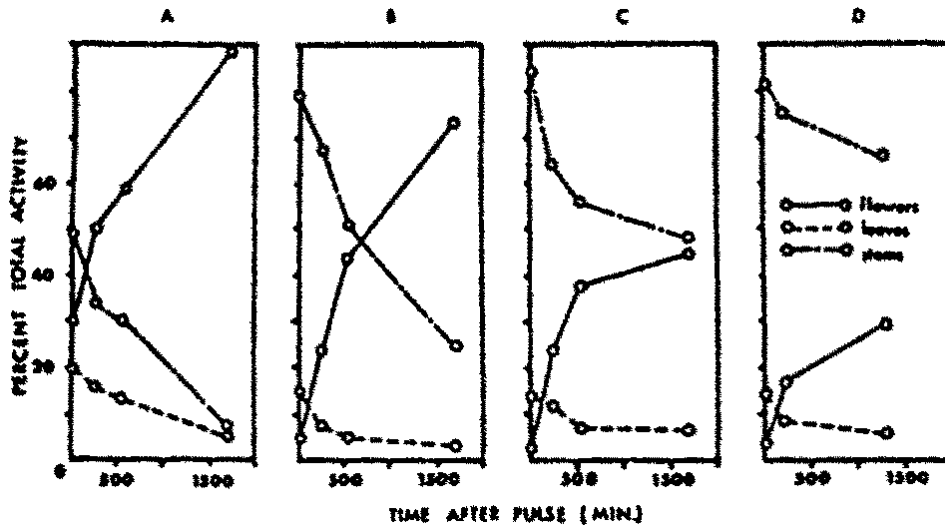


Figure 2. Distributional changes of  $^{14}\text{C}$  in cut carnations after taking up  $^{14}\text{C}$ -sucrose one hour. A, pulsed immediately after harvest; B, pulsed 1 day after harvest; C, pulsed 2 days after harvest; D, pulsed 3 days after harvest.

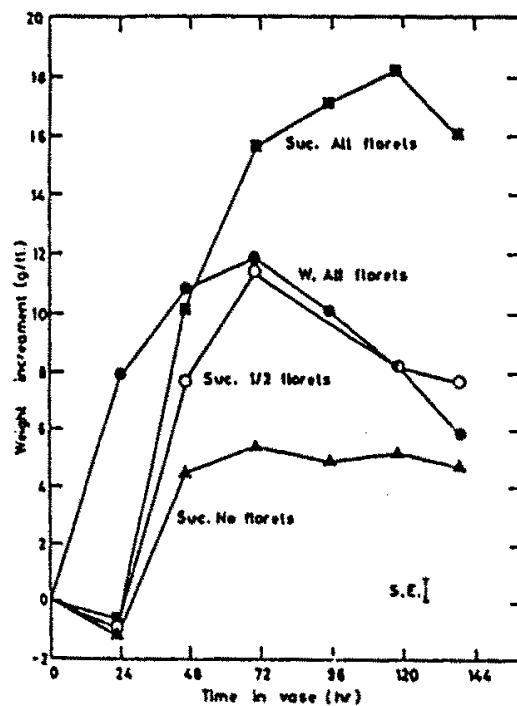


Figure 6. Weight increment of gladiolus flowers (cv. Osear) held continuously in tap water (W) or conditioned for 24 hrs in 20% sucrose solution (Suc.) and then transported to water. All florets remained, half number of florets removed (florets) or all florets removed (No florets)

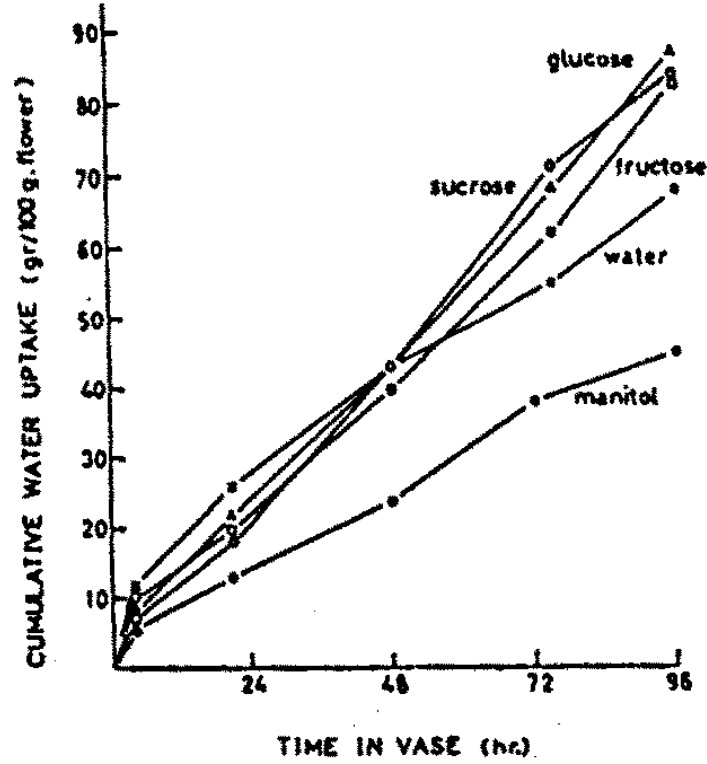


Figure 5. Cumulative water uptake (in g water to 100 g initial fresh weight of flowers) of glandiulus flowers (cv. Osear) held in 0.6M solutions of various sugars (Mayak, Bravde, Gvilli and Halery, 1972)

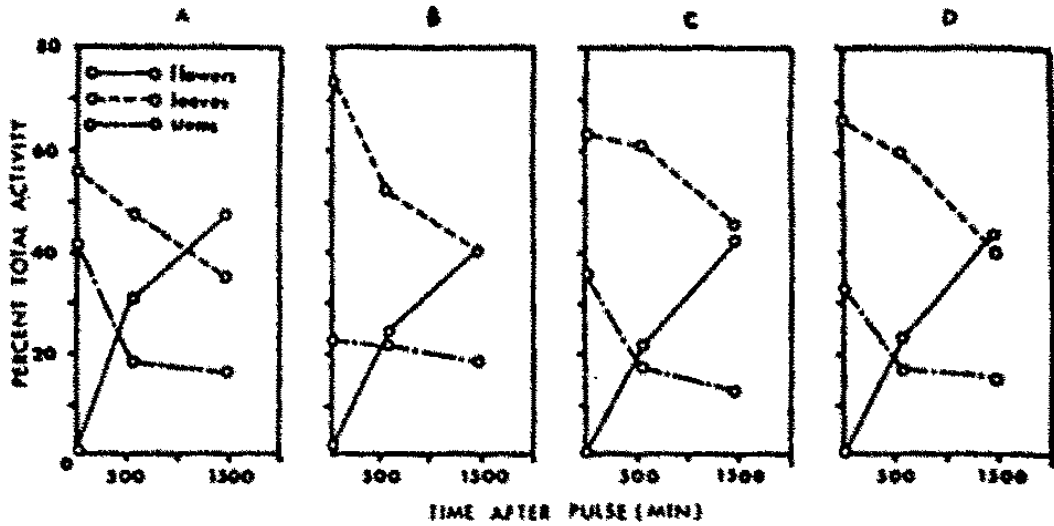


Figure 1. Distributional changes of <sup>14</sup>C in cut roses after taking up <sup>14</sup>C-sucrose one hour. A, pulsed immediately after harvest; B, pulsed 1 day after harvest; C, pulsed 2 days after harvest; D, pulsed 3 days after harvest.

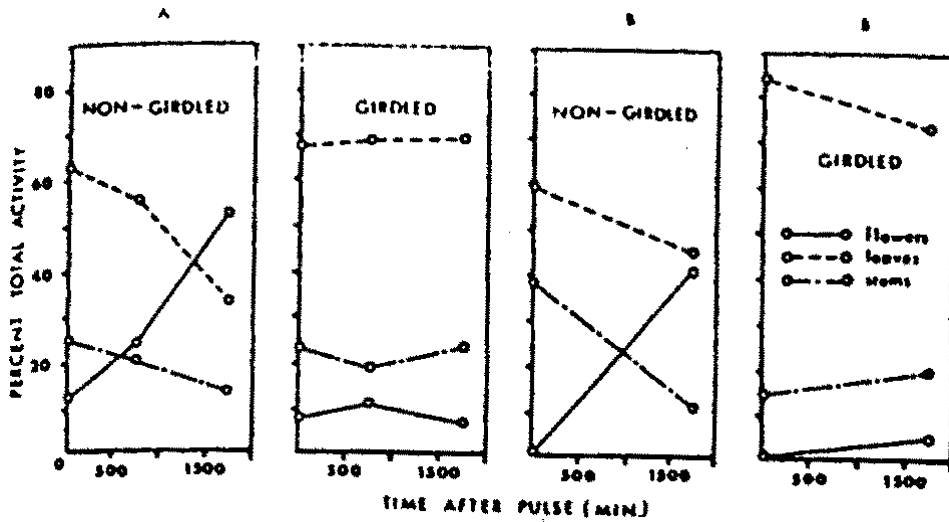


Figure 3. Distributional changes of  $^{14}\text{C}$  in girdled and non-girdled roses after taking up  $^{14}\text{C}$ -sucrose one hour. A, pulsed immediately after harvest; B, pulsed 1 day after harvest.

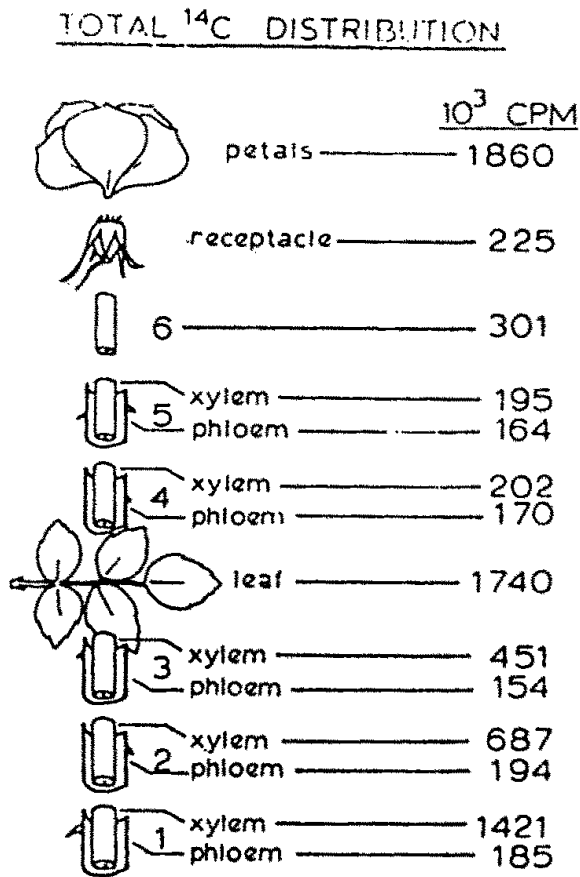


Fig 3. Distribution of  $^{14}\text{C}$  in various cut rose portions after a 45 min uptake of  $^{14}\text{C}$ -sucrose.

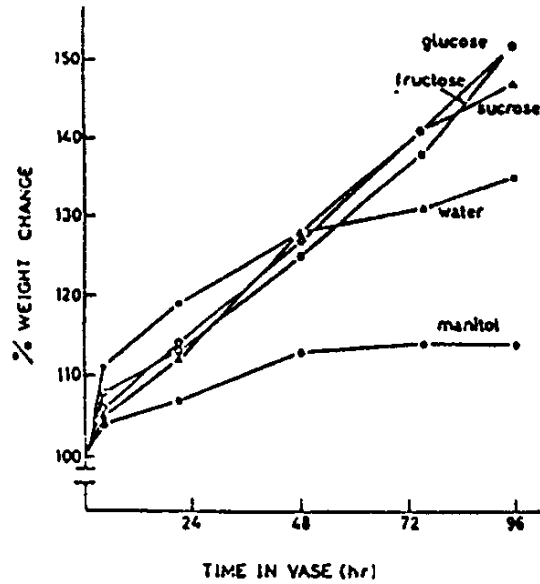


Figure 3. Parent weight change of glandiolum flowers (cv. Oscar). Flowers were not conditioned (Dry) or conditioned in water or in 20% sugar solution for 20 hrs, held in carton at 22°C for 24 hrs as an air shipment simulation, then reout and placed in tap water (Mayak, Bravde, Gvilli and Nalevy, 1972).

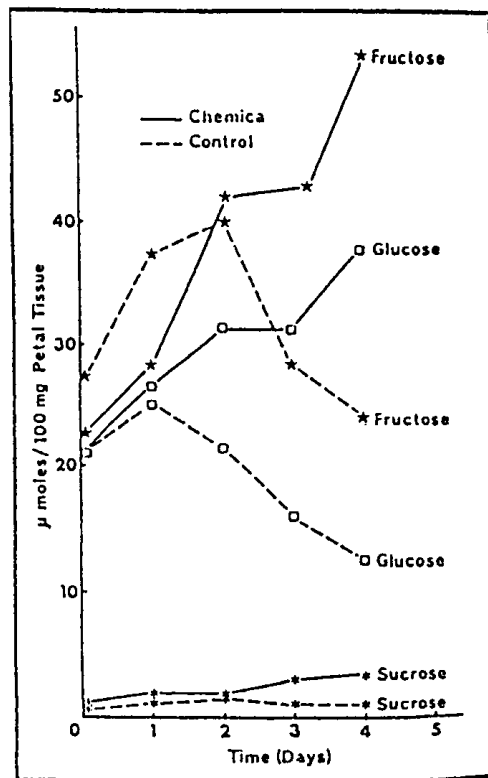


Fig. 5. Endogenous sugar content of petal tissue of flowers maintained in distilled water (control) or in modified Cotnell solution (chemical).

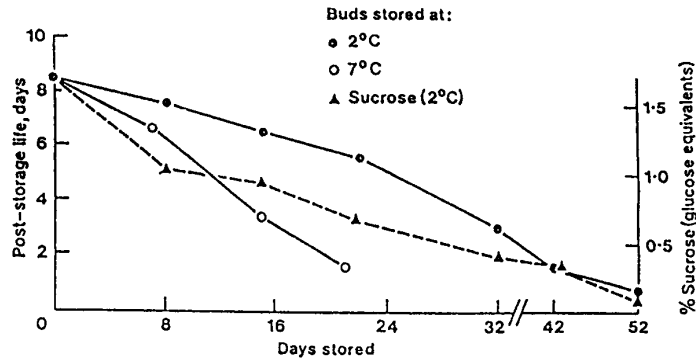


Figure 3. Post-storage life of narcissus buds and residual sucrose measured when buds were removed from store; reducing sugars have been omitted. (see text).

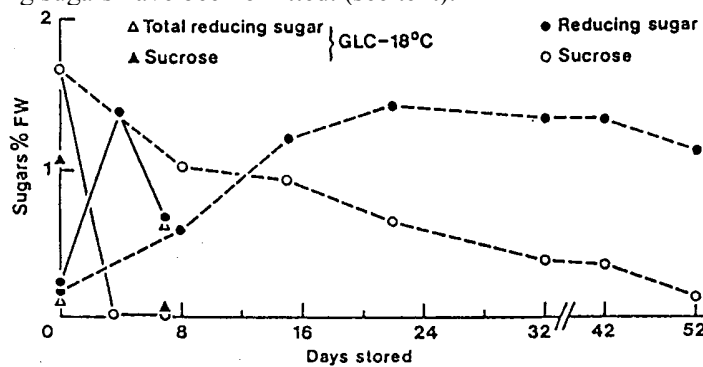


Figure 2. Sugars in narcissus buds before and after storage at 18°C (solid line) and 2°C (broken line); flowers were sampled immediately after storage.

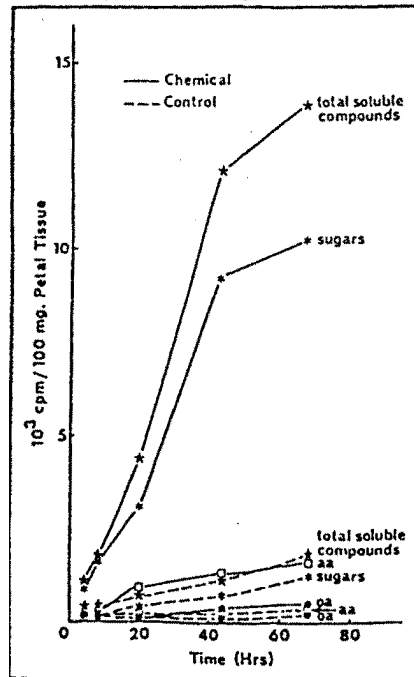


Fig 2. Distribution of <sup>14</sup>C-label in ethanol-soluble compounds of petal tissues of flowers maintained in distilled water or in chemical (modified Cornell solution). <sup>14</sup>C-sucrose (3.5 uc. sp. act. 4.88 mc/m<sup>2</sup>. uniformly labelled) was added to each solution.

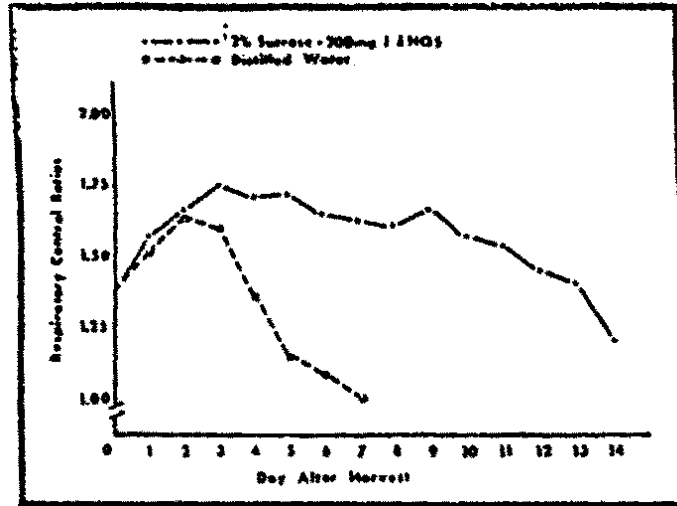


Fig. 2. Respiratory control ratios of mitochondria isolated from rose petals from flowers maintained in either distilled water or the modified Cornell Solution (2% sucrose + 200 mg 8-HQS/liter).

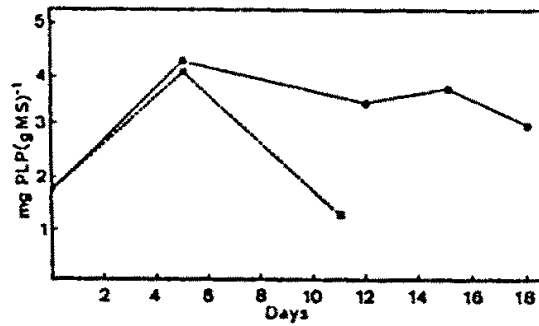


Figure 8. Phospholipid contents of petals of carnations supplied with water (dashed line) or with sugar solution (continuous line)

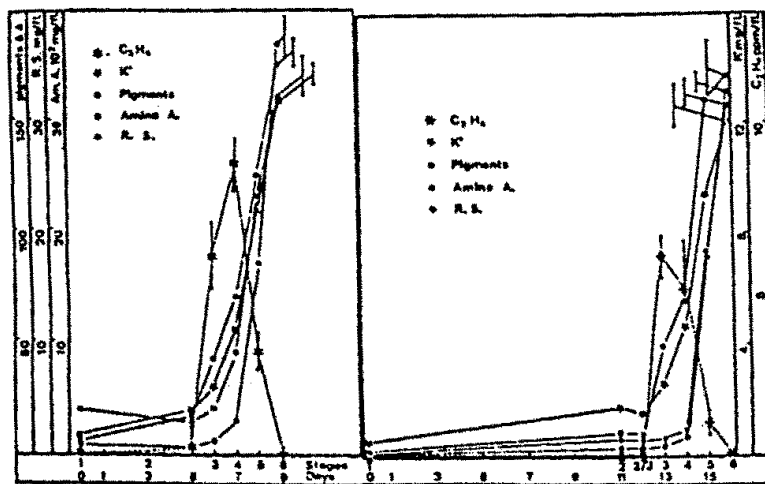


Figure 7. Exudation of  $K^+$ , pigments, amino-acids and reducing sugars, and ethylene evolution by carnation petals. Flowers fed with water (left), or with glucose solution (right).

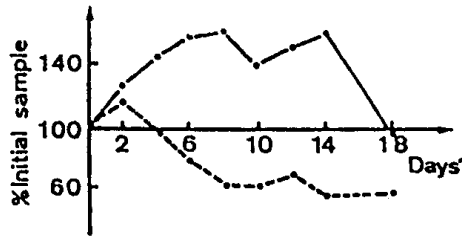


Figure 1. Protein content of Scania carnation flower fed with water (dashed line) or with a sucrose solution (continuous line).

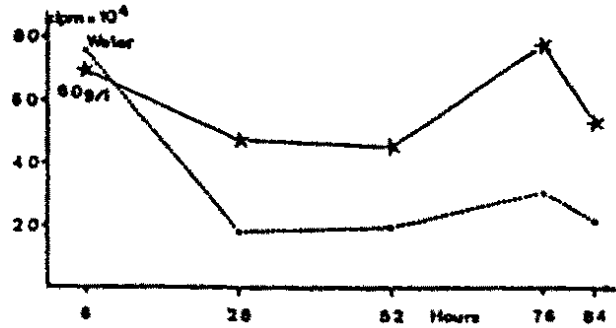


Figure 2. Protein radioactivity of *Iris germanica* fed with water or with a glucose solution (60 g/l). <sup>14</sup>C-glucose was supplied during 2h, starting 6h before each sampling time (Paulin, 1975)

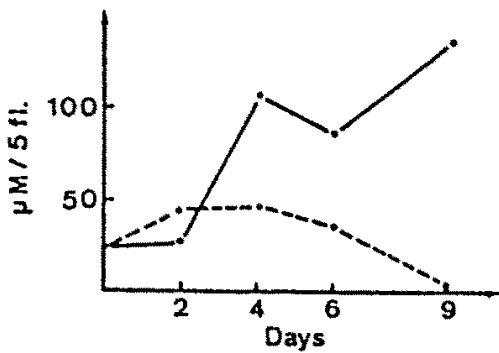


Figure 3. Clutamine content of Scania carnation flowers supplied with water (dashed line) or with a sucrose solution (continuous line).

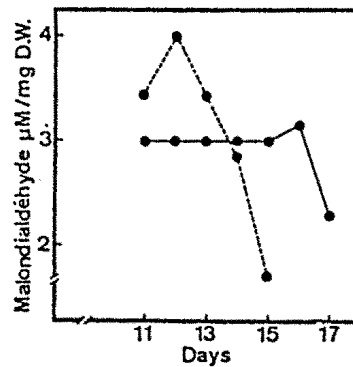


Figure 9. Malondialdehyde in petals of carnations supplied with water (dashed line) or with a sugar solution (continuous line).

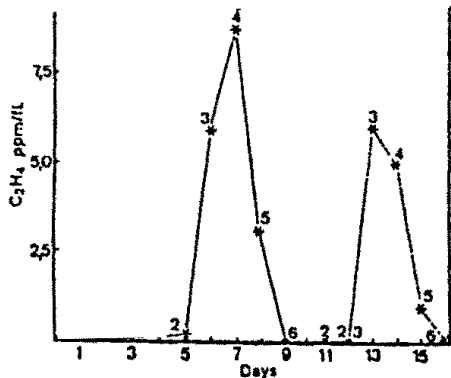


Figure 6. Ethylene production by petals of carnations supplied with water (continuous line) or with a sugar solution (dashed line).



Fig. 1. Time course of changes in fresh weight (△), respiration (●) and ethylene production (□) during senescence of cut carnation flowers. "S" indicates the appearance of wilting symptoms.

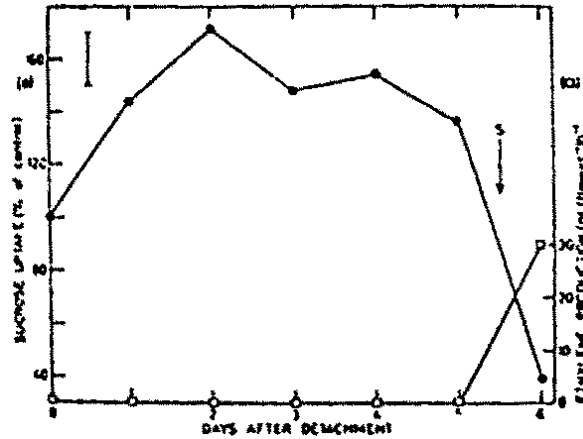


Fig. 2. Changes in the rate of sucrose uptake (●) and ethylene production (□) during development and senescence of carnation petals. Rate of uptake was evaluated using petal discs incubated in [<sup>14</sup>C]-sucrose solution for 1-h. "S" indicates the appearance of wilting symptoms. Sucrose uptake values were calculated as percentage of control (initial value at time-0). Vertical bar indicates 6SE.

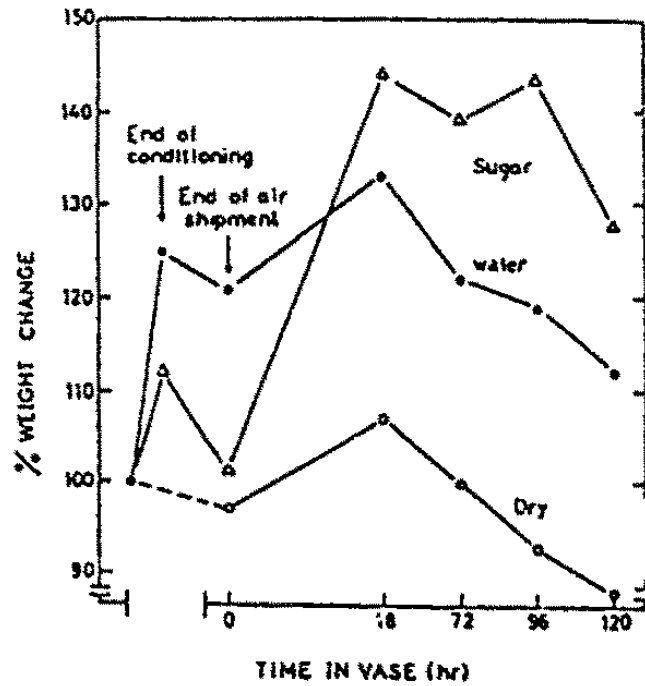


Figure 4. Percent weight change of gladiolus flowers (cv. Oacar), held in 0.6M solutions of various sugars (Mayak, Sravdo, Gvilli and Halevy, 1972)

Table 3. The effect of sugar concentration on the opening and vase life of miniature gladiolus cv. Rose Charm (Values within each column not followed by the same letter are significantly different at the 5% level)

Treatment	No. of open florots	Vass life** (days)
No conditioning*	2.8 b	4.8 b
Conditioning .0% sugar	3.0 b	4.8 b
0 1.0% 0	3.3 b	4.8 b
0 2.5% 0	3.0 b	5.1 b
0 4.5% 0	3.8 b	5.0 b
0 7.5% 0	3.7 b	5.5 b
Continuous 4.5% 0	6.2 a	7.8 a
Devaloped in the filed	6.5 a	

\* Flowers were held dry while other treatments were performed

\*\* Vase life was terminated when two lower florots wilted.

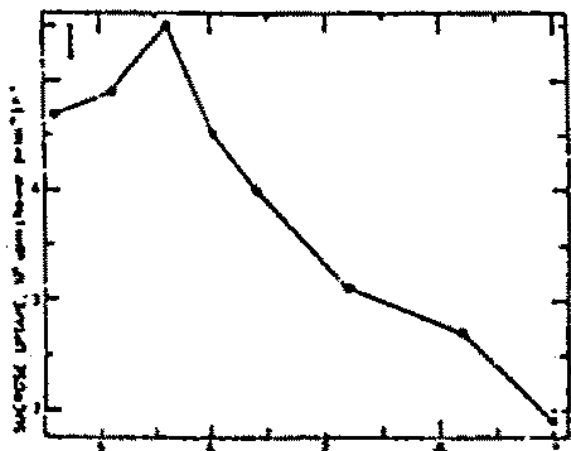


Fig. 4. The effect of pH on [<sup>14</sup>C]-sucrose uptake by petal discs from carnation flowers. Rate of uptake was evaluated as in Fig. 2. Vertical bar denotes 6SE.

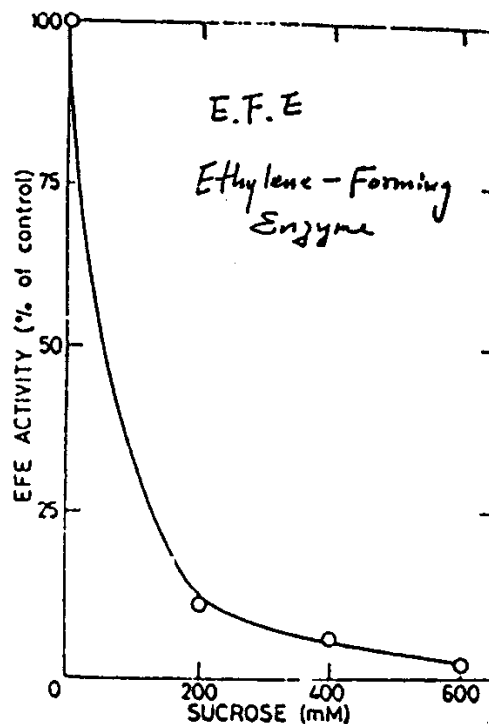


Fig. 2. The effect of sucrose concentrations on solubilized EFE activity. Membranes were treated with 0.6% NP-40 detergent, and the activity in the supernatant was determined. The specific activity of the control (solubilized membranes in buffer)

was 1110 nl ethylene/h.mg protcin.

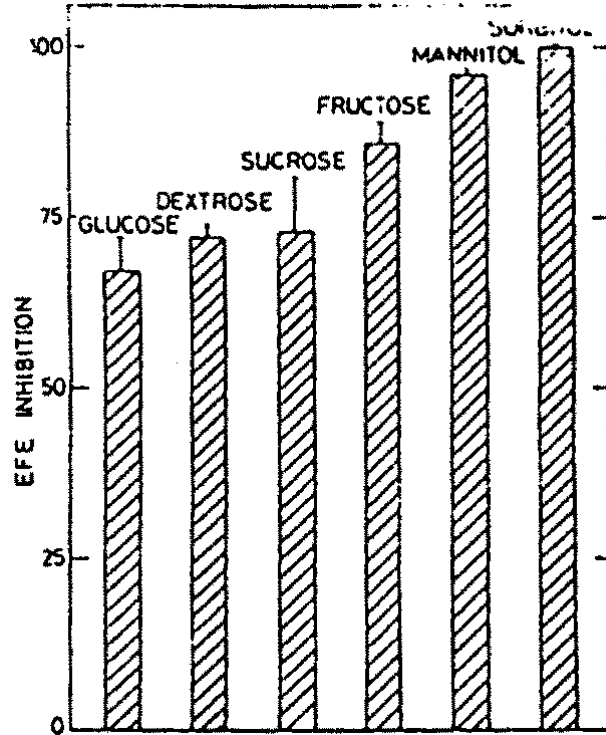


Fig. 3. The effect of different sugars at 40 mm on solubilized EFE activity. Membranes were treated with 0.6% NP-40 detergent, and the activity in the supernatant was determined. The specific activity of the control (solubilized membranes in buffer) was 900 nl ethylene/h.mg protein.

Table 1. Analysis of sugars and starch in leaves of 'Deep Tuneful' in relation to sucrose concentration in the preservative solution, and leaf damage. The leaves in 6% sucrose after 4 days were separated according to leaf damage symptoms.

Time (days)	Treatment (% sucrose)	Number of samples	Percentage of total dry weight			Leaf damage
			Heducing Sugar	sucrose	Starch	
0	2	4	3.9	0.8	1.6	none
4	0	4	4.1	0.3	1.0	none
4	6	3	5.8	26.7	3.2	severe
4	6	1	4.6	3.5	1.7	none