

# 水及添加物對玫瑰切花保鮮之影響

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## 一、前言

玫瑰美麗的花色及形狀深受大眾所喜愛，而有“花后”之稱，可惜其花期不長，觀賞價值大受影響，「折頸」及「開花不完全」是常見的問題<sup>(9)</sup>，因此如何延長切花壽命是玫瑰切花生產的重要問題之一，水的供應更是玫瑰切花保鮮之關鍵點<sup>(3,4,5)</sup>，適當地利用荷爾蒙或殺菌劑或乙稀抑制劑或碳水化合物或抗氧化劑等化學物質添加物將有助於切花壽命之延長<sup>(3,7,24,28,29,33)</sup>。本文將針對水分及添加物對玫瑰切花之影響，進行相關之探討。

## 二、水對玫瑰切花保鮮之影響

由於切花採收後蒸散作用與呼吸作用持續進行，當水分損失量超過吸收量時，花朵就會呈萎凋現象<sup>(3)</sup>，一般來說失水過於嚴重，就會提早老化而影響瓶插壽。(5)。有時即使再吸收回原來的水份，但事實上已嚴重地影響了瓶插壽命(5,9)。植物體藉蒸散作用將液態水分轉成氣態而散出體外，水在氣化時會吸收熱量，因此植物可利用蒸散作用來降低本身過高之溫度，但另一方面卻失去內部之水分，水分損失易導致外觀新鮮度降低，缺少完美感，此外，會引起乙稀之大量產生而使花卉老化，終使商品價值急速降低。(5)。

玫瑰花的花梗細胞不具木質化，當水份吸收不足，細胞失去膨壓，花頸因無法支撐花朵之重量而下垂，這種現象稱之為『垂頸』<sup>(3,7,16)</sup>。這種水分減少的原因是由於維管束堵塞<sup>(19)</sup>，可能是氣泡堵塞<sup>(31)</sup>或微生物產生之代謝物堵塞導管<sup>(17)</sup>或切花莖端纖維素酵素活性增加，產生大量果膠分解物引起導管堵塞所致。<sup>(19,27)</sup>。

影響水分平衡的因子很多，例如品種的不同、花的開放狀態，生長情形，水質等因素。在有關水對玫瑰切花保鮮影響之報告指出，切花運輸方面在72小時後以乾式輸送失水已達22%，而濕式輸送則仍維持較原來多5%之鮮重<sup>(14)</sup>。在氣孔關閉方面，乾式輸送則隨著時間明顯增加，濕式則無明顯變化<sup>(14)</sup>。在水的通導性方面，乾式及濕式輸送均會隨著時間而降低，但乾式降低的比率則明顯比濕式大很多<sup>(14)</sup>。在比較水分損耗率方面，發現乾式輸送中，葉片損耗率最高達23%以上，而莖及花在10%以下<sup>(14)</sup>。以濕式輸送較乾式輸送在延緩玫瑰花的開放速度上效果較好，並且有較長的瓶插壽命反較好的<sup>(11)(13)</sup>品質。乾式輸送較濕式輸送玫瑰的呼吸率較高。<sup>(11)</sup>。濕式貯藏之使用將成為未來研究發展的趨勢之一<sup>(29)</sup>。目前在國內花市除採用過去傳統紙箱裝外，目前已有部分改為以「立式含水容器」進行運輸作業亦即是濕式輸送，使玫瑰切花一直插在水中或保鮮液。方法是切花從田間採收後迅速插水，在運輸、販賣的過

程一直插在水中，甚至到零售商仍然插在水中，玫瑰這種對水極為敏感之切花種類，以這種方式運輸，對品質有相當大的助益。但須注意水桶及水質的乾淨。如果在水中加入保鮮劑處理則有更好之效果<sup>(6)</sup>。

玫瑰切花離水的時間愈短愈好，而使用水輸送也須注意避免菌類的危害。濕式運輸再配合冷藏低溫，則有更好的效果。<sup>(18)</sup>

在水質方面浸用水應保持乾淨，花瓶水中有細菌100萬個以上存在，則切花壽命必然急遽縮短<sup>(2)</sup>。以荷蘭最重要的玫瑰“Sonia”栽培品種為研究對象，發現瓶水中的細菌數達到 $3 \times 10^9$ 個/ml時，玫瑰會在1個小時內萎凋。<sup>(17,32)</sup>。菌類—真菌及細菌被發現在剛採收之切花內及插花之容器內，菌類的多寡會影響切花之瓶插壽命，因此，在商業上處理切花須預防切花及瓶水內之微生物活性。<sup>(26)</sup>在玫瑰花上防止水分的缺乏而影響瓶插壽命是一顯著重要因子。將切花插於大型水桶進行所謂的「水養」，歐美多已棄用此法，因搬運費力，且水桶中常混有細菌、真菌，乃至於藻類，這些污染物均會減低切花品質，故稱之為「水桶症狀群」(Buckersyndrome)。<sup>(8)</sup>。利用玫瑰莖底部在水中剪一刀或是水酸化均可促進水分的吸收<sup>(30)</sup>。在零售商建議處理：玫瑰切花以 $40 \sim 43^\circ\text{C}$ 的溫水浸漬，並調整 $\text{pH}=3$ ，吸水30到60min。<sup>(30)</sup>

決定花卉瓶插壽命的一個決定因素就是濕度，低RH濕度會促進蒸散作用，引起缺水，尤其在乾式貯藏中，在貯藏室中RH應在 $90 \sim 95\%$ 。<sup>(29)</sup>。在低濕度成長的玫瑰切花比在高濕度下有較長的瓶插壽命<sup>(25)</sup>。

### 三、添加物對玫瑰切花保鮮之影響

玫瑰的老化過程應是：膜中脂質結構改變→增加微黏性→脂層相分離→乙稀生成量上升→膜之通透性增加<sup>(7)</sup>。切花採收也是一種逆境(Stress)，Sugar and lipid interaction(糖及脂質相互反應)在維持膜完整扮演相當重要的角色<sup>(7)</sup>。

玫瑰對乙稀輕微之反應，乙稀會促使玫瑰花凋謝。另外病蟲危害、組織受傷、壓力均會促使乙稀產生，所以處理時應小心，不能硬擠、硬塞使切花受傷，以免對切花產生危害<sup>(23,28)</sup>。0.2ppm的乙稀即會造成玫瑰不開花或提早凋謝。<sup>(10)</sup>。若有乙稀過敏反應時可添加STS (Silver thiosulphate)<sup>(28)</sup>。STS對乙稀造成之萎凋有預防之效果，但對吸水不良導致之枯萎或觀賞價值之下降卻無效果，如用界面活性劑(洗潔精劑)，則有相當之效果，因為它可以促進吸水。<sup>(2)</sup>。日人以PPOH (Cis-Propenylphosphonic acid丙稀基磷酸)可以抑制乙稀的自發性產生。以5mM及10mM的PPOH及水三者比較玫瑰切花“Sonia”發現瓶插壽命有較長之現象，因其明顯延緩切花開放程度，切花鮮重以5mM有明顯增加。在低溫時 $10^\circ\text{C}$  PPOH的效果明顯較高溫 $20^\circ\text{C}$ 時效果好。<sup>(21)</sup>長期貯藏後切花乙稀量會激劇上升，因此長期貯藏後切花壽命縮短約4天<sup>(34)</sup>。在冷藏庫乙稀的生成量在1週內是被抑制的，但一週後乙稀增加的速率是很快的，因此切花最好不要超過一週。<sup>(14)</sup>。長期能冷藏前添加STS-Sucrose均可以延長切花壽命，但以冷藏後加比

冷藏前加入的效果較佳<sup>(34)</sup>。

切花採收後乾物質明顯減少，而呼吸消耗及蒸散作用仍在進行，組織內的有機物質轉換成CO<sub>2</sub>、水及能量，以維持基本的代謝過程，消耗到一定程度後，切花組織便進入衰老狀態<sup>(1,3,4,22)</sup>。可以1~3%蔗糖供應，提供作為呼吸的基質，可增加切花之重量，使氣孔關閉減少切花之蒸散作用，增加花瓣之吸水能力，提早開花，延長玫瑰切花壽命<sup>(3,4,5)</sup>。但須注意菌類的滋生繁殖。但也有報告指出外加蔗糖的主要功用似乎是維持粒線體膜的完整，而非提供作為呼吸基質<sup>(7)</sup>。玫瑰長期貯藏添加Sucrose3%（18h at 1°C）可以延長切花壽命1天，而且在冷藏後插比冷藏前效果良好<sup>(34)</sup>。

前處理預措液可用RVB（內含Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>可抑制花枝切口大量聚積『聚苯』等化合物）。保鮮劑以內含100~200ppm的8-HQS或8-HQC之殺菌劑處理<sup>(18,5)</sup>。添加植物生長調節劑。Cytokinin、GA和植物生長抑制劑SADH或C.C.C.可延緩植物之衰老<sup>(7)</sup>。其主要作用為延緩蛋白質和葉綠素的分解，減慢呼吸速率，維持其活力。適當的使用蓄冷劑（Ateka Aool）可使在輸送中保持低溫或冷涼<sup>(1)</sup>。添加CO<sub>2</sub><sup>+</sup>則可則可促進水分的吸收<sup>(33)</sup>。添加Ca(NO<sub>3</sub>)<sub>2</sub>則可減緩開花的速率<sup>(20)</sup>。添加抗氧化劑GSH. Kaempferol、Morin等可延長切花壽命三天<sup>(24)</sup>。亦有添加吸水性樹脂，增加切花水分的吸收<sup>(12)</sup>。花色變藍與PH值有關。因此添加cornell配方的保鮮劑蔗糖5%，8-H s200ppm,醋酸銀50ppm）能維持切花的PH值不變，而保其原來的色澤<sup>(15)</sup>。

#### 四、參考文獻

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Table 1

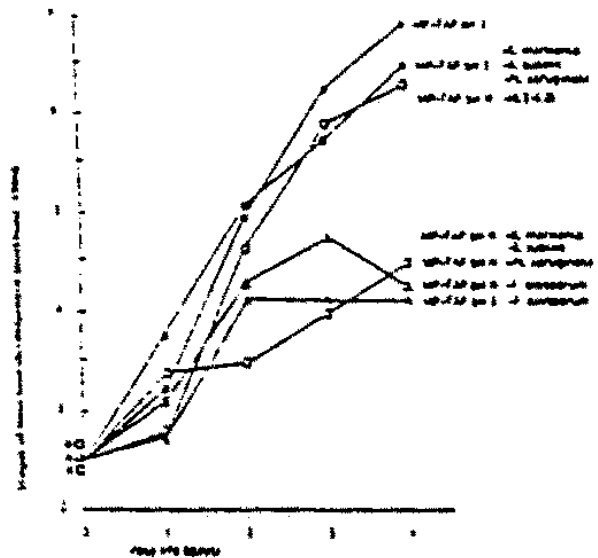
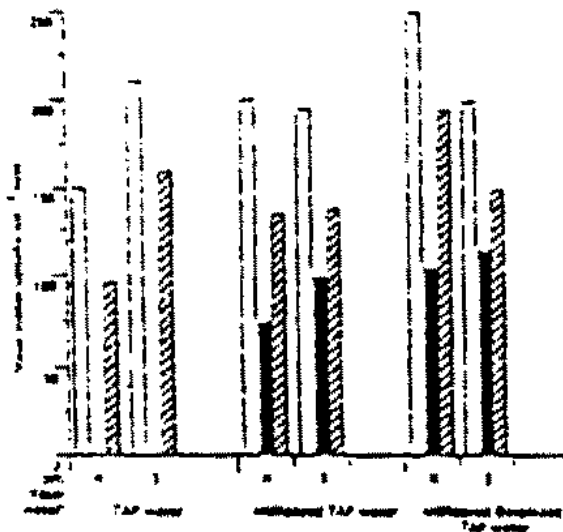
Water potential measurements (MPa) of the poduncle section of Rosa cv. 'Kardinal'

Vase life (h)	48	96	48	96	
Vase water	pH	6.5-7.0	Buffer	pH 3	
TAP	N	NT	-1.3	NT	-0.25
	+ Bac.	NT	NT	NT	NT
	+ Pus.	NT	-2.4	NT	-2.0
	+ Kl.	NT	-1.5	NT	-0.35
MP-TAP	N	-0.6	-1.4	-0.15	-0.2
	+ Bac.	NT	-2.1	NT	-0.6
	+ Pus.	-1.2	-2.4	-0.8	-2.0
	+ Kl.	-1.2	-1.5	-0.2	-0.35
MP-OT	N	-0.25	-0.8	-0.15	-0.25
	+ Bac.	NT	-1.45	NT	-0.3
	+ Pus.	-0.9	-2.0	-0.5	-1.65
	+ Kl.	-0.6	-1.2	-0.2	-0.45

MP=Millipore filtered, 0.47/um pore diam.  
 DI=Deionized. N=no inoculation; NT=not tested;  
 n=4. Vase water inoculatoin 5.101 ml-1 cells of:  
 Bac. =Bacillus subtilis; Pus. =Pusarium oxysporum  
 Kl. =Kluyveromyces marxianus.

Table 1. Effect of 0.5 ppm ethylene for 2 days on flower opening of different rose cultivars.

Cultivar	Ethylene effect on onenins
Angel	accaleration
Bettina	acceleration, abscission
Candia	accaleration
Capella	abscission
Cara Mia	acceleration
Cellca	distortion
Cerisa	acceleratoin
Chantilly Lace	inhibltion
Coed	no effect
Excitement	acceleration
Golde Rush	no effect
Golden Fanusy	acceleration, abscission
Golden Times	no effect
Golden Wave	acceleration
Grace	no effect
Jack Frost	acceeration, distortion
Lady Diana	no effect
Lavande	acceleration, abscission
Lovely Gril	inhibition
Paul's Pink	acceleration
Prive	abscission
Royalty	disiortion
Sonia	abscission
St. Louis	inhibition, abscission
Sterting Silver	acceleration
Tobone	acceleration, abscission
White Success	acceleration



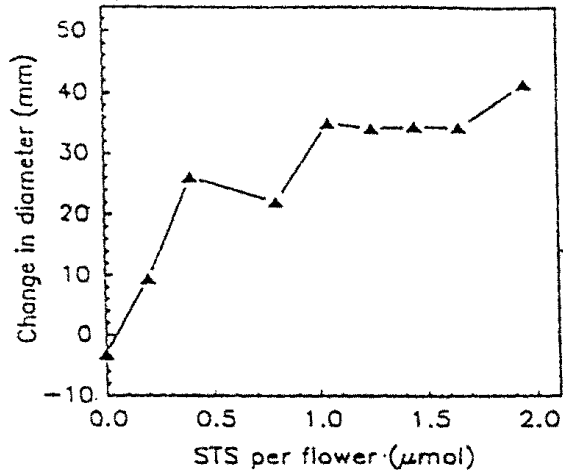


Figure 3. Change in diameter (relative to diameter at beginning of experiment) of 'Lovely Girl' flower, exposed to 0.5 ppm ethylene for 3 days, as a function of STS quantity per flower stem.

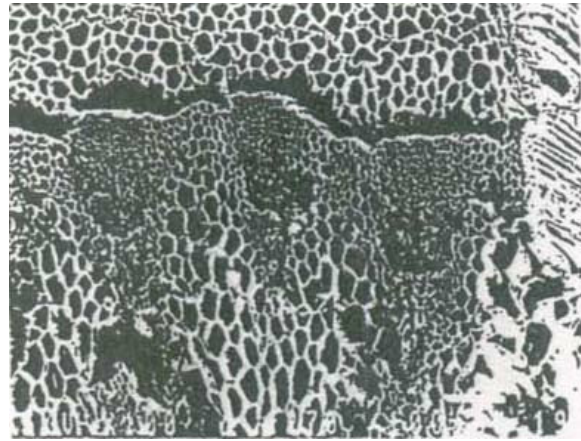


Fig. 2. SEM of a cross section of the cut surface of Gerbera cv. "Fleur" held 24 h in sterilized tap water. Bar mark represents 100  $\mu\text{m}$ .

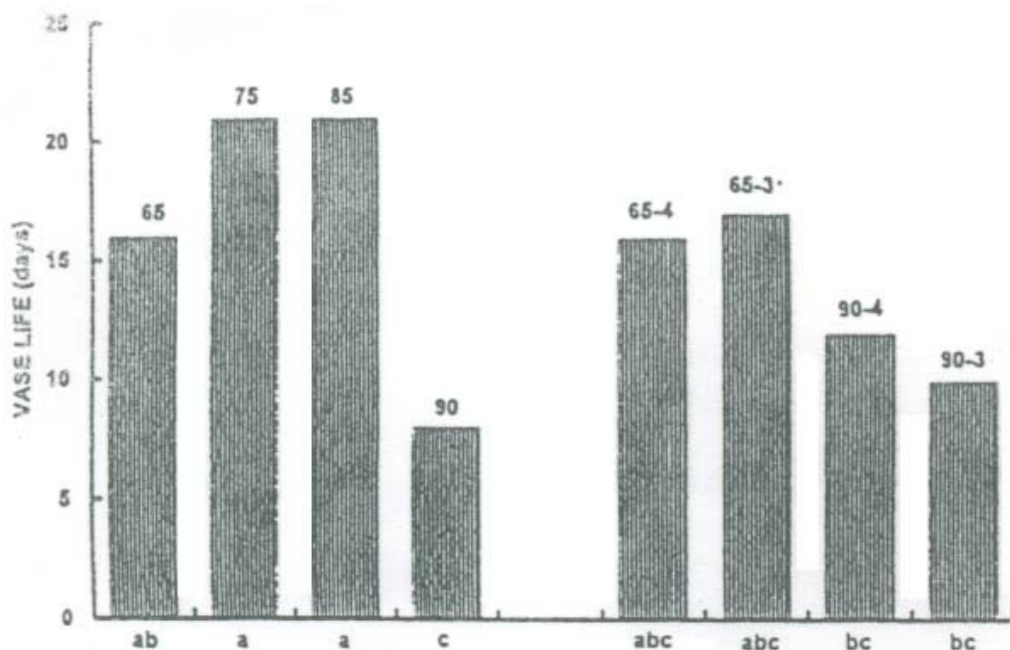


Figure 1. The effect of different air humidities (% RH is indicated on top of the columns) on the vase life of cv. Souvenir. In the four treatments to the right the plants were first grown at 90% of 65% RH, and thereafter transferred to 65% or 90%, respectively, in the last four (65-4 and 90-4) or last three weeks (65-3 and 90-3) of growth before flowering. Different letters below the columns indicate significant difference between the treatments according to Duncan's multiple range test at  $p < 0.05$ .

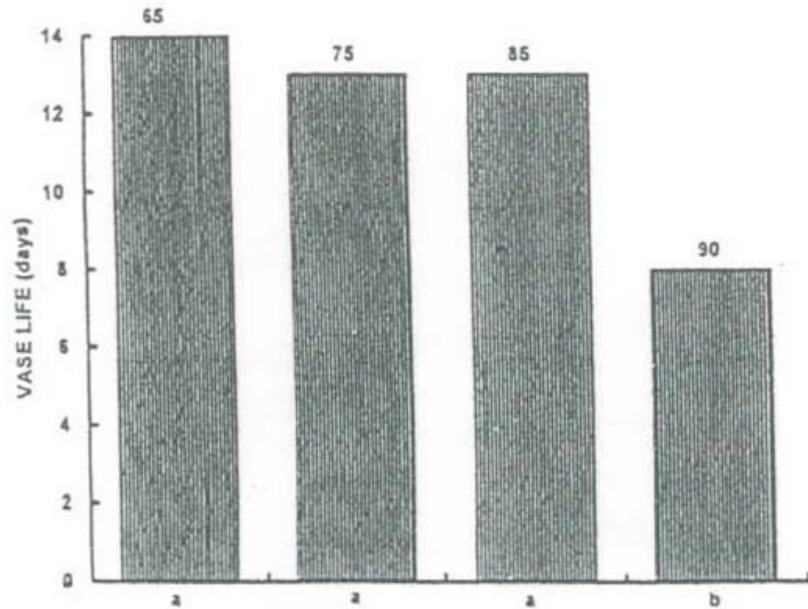


Figure 2. The effect of different air humidities (% RH indicated on top of the columns) on the vase life of cv. Baronesse.



Fig. 3. SEM of a cross section of the cut surface of Rose cv. "Sonia" held 24 h in vase water to which ca.  $5 \times 10^7$  /ml of B. polymyxa cells were added.

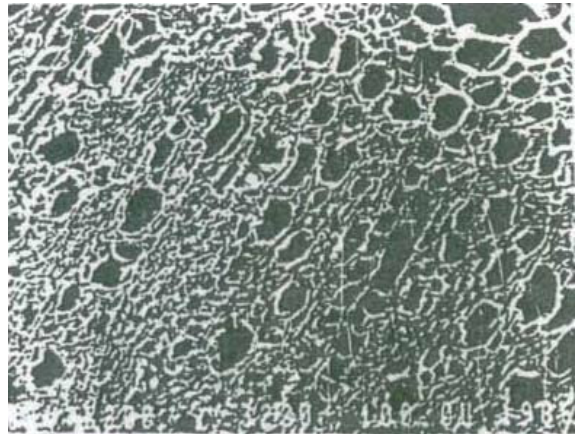


Fig. 1. Scanning Electron Micrograph (SEM) of a cross section of the cut surface of Rose cv. "Sonia" held 24 h in sterilized tap water. Bar mark represents 100  $\mu$ m.



Fig. 4. SEM of a cross section of the cut surface of Rose cv. "Sonia" held 24 h in vase water to which ca.  $3 \times 10^6$ /ml of *F. oxysporum* myc. segn. were added. Bar mark repr. 100 $\mu$ m

with preservative solution (8-HQS+S), alone or enriched with calcium nitrate, on keeping quality of cut roses

Treatment	Diameter (mm)	Final flower stage	Vase life (days)
Continuous treatment			
H <sub>2</sub> O	71.4 a	3	5.7 a
8-HQC+S	96.2 d	4	9.0 cd
8-HQC+S+Ca(NO <sub>3</sub> ) <sub>2</sub> 0.25%	76.3 c	3	11.8 e
8-HQC+S+Ca(NO <sub>3</sub> ) <sub>2</sub> 0.5%	71.2 b	3	12.2e
20 h. conditioning			
8-HQC+S	95.6 d	4	7.0
8-HQC+S+Ca(NO <sub>3</sub> ) <sub>2</sub> 0.5%	93.3 d	4	8.3 c
8-HQC+S+Ca(NO <sub>3</sub> ) <sub>2</sub> 1%	94.2 d	4	10.3 d

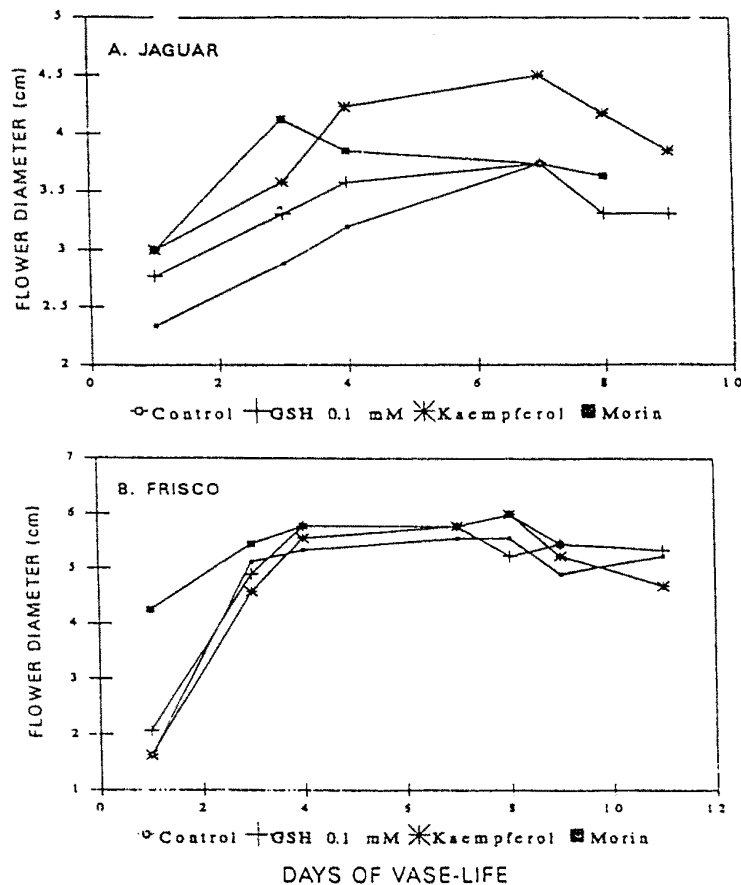


Figure 2A.B. Effect of antioxidants on degree of flower opening of the rose cultivars 'Jaguar' (A). 'Frisco' (B). Roses were harvested at tight bud stage, loaded with morin, kaempferol or GSH at the indicated concentrations for 20 h at 22°C, and incubated in 8-HQC (0.2%)+STS (0.1%) solution. Flower diameter was recorded daily, and results represent average measurements of 5 flowers. Lack of symbols in graph (B) indicates limited vase-life, since flowers were discarded.

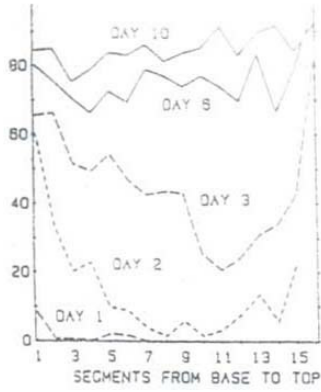


Figure 4. Initial air flow as per cent of maximum rate, shifting from very low values on day 1 to 80-90% on day 10. Further details: text Section 3.2.

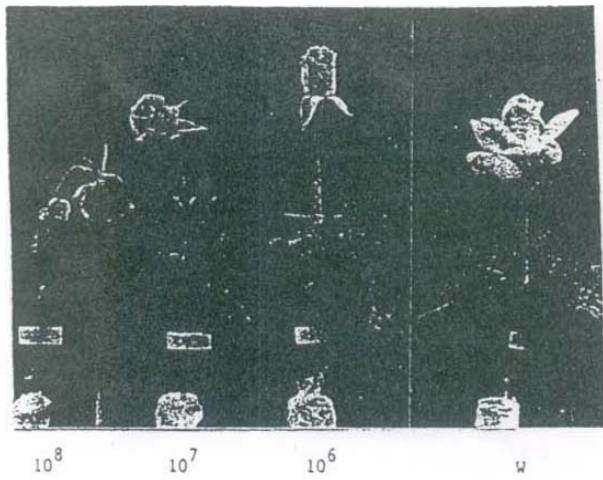


Fig. 7

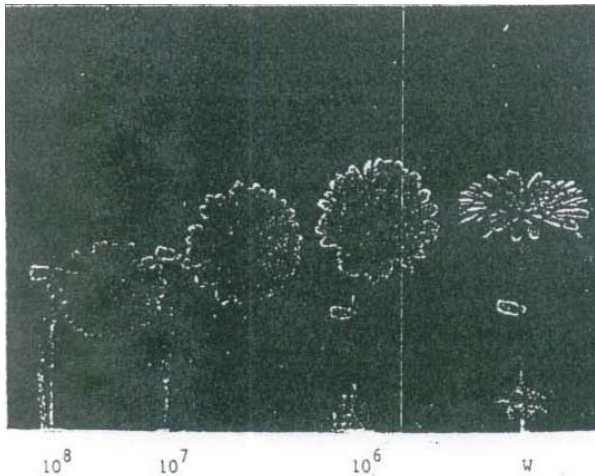
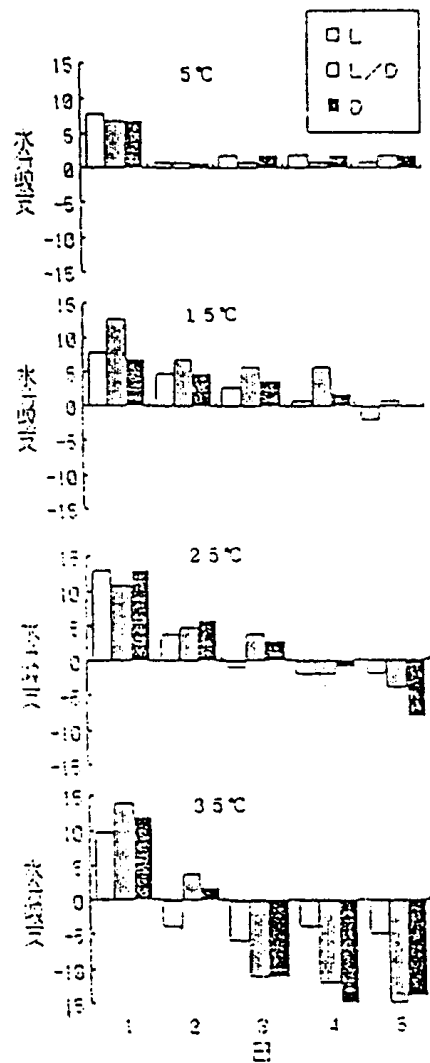


Fig. 8

Rosa cv. "Sonia" (Fig. 7) and Gerbera cv. "Fleur" (Fig. 8) after 3 d of vase life when *B. subtilis* cells: resp.  $10^8$ ;  $10^7$ ;  $10^6$ /ml initially were added to the vase water and control flowers were placed in sterilized water (W).



第4圖 水分吸受【吸水量 (g/dm<sup>2</sup> · 日) - 蒸散量 (同)】

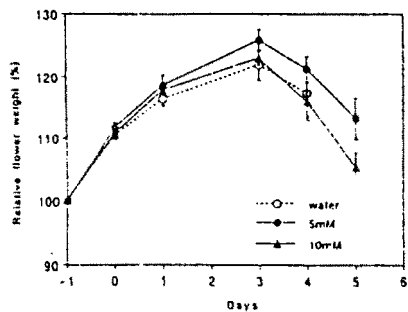
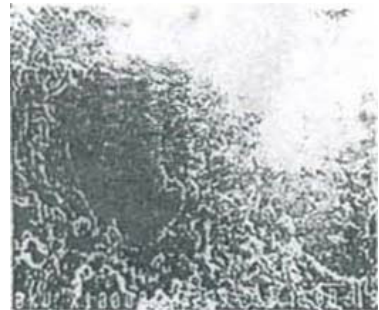


Fig. 3. Relative weights of cut rose 'Sonia' flowers pulse-treated with PPOH at 20°C. Flowers were immersed in a 5 or 10 mM PPOH solution or in deionized water for 20 hr. On and after 0 day the flowers were held in vase water (deionized water). The weight of the flower on the first day was assumed to be 100% and subsequent weights were referred to as percentage of this initial value. Values are mean ±SE (n=5).

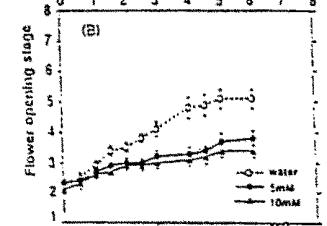
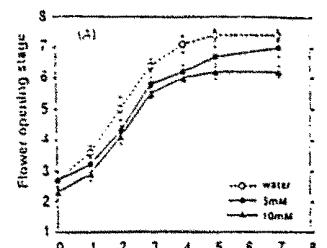
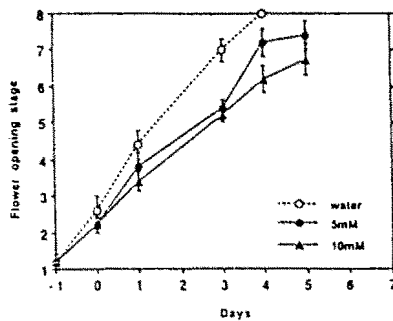
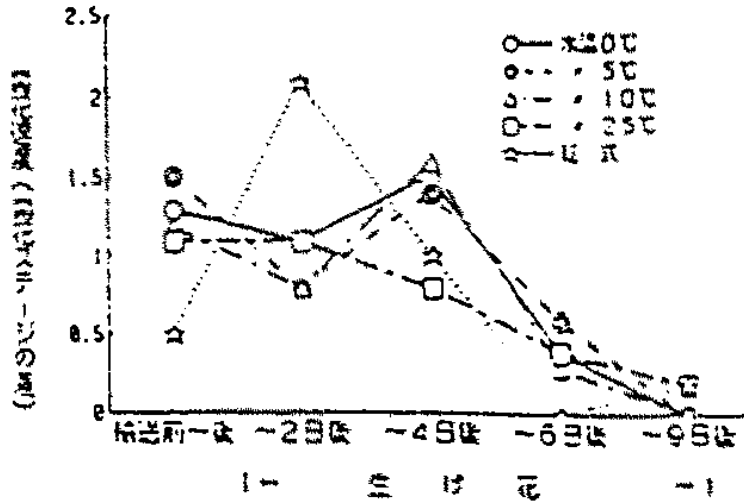
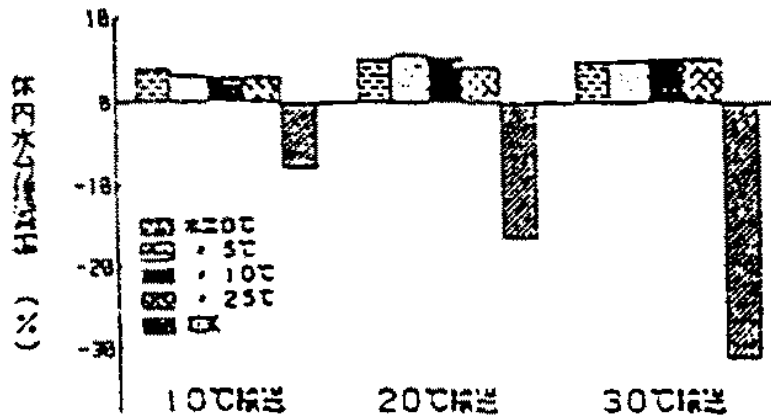


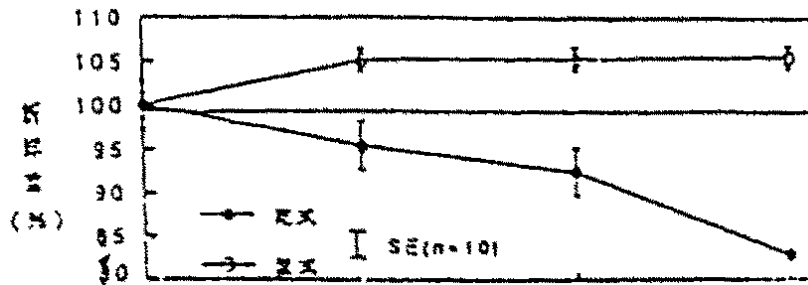
Fig. 2. Effect of PPOH pulse treatment on rose 'Sonia' flowers at 20°C. Flowers were immersed in a 5 or 10 mM PPOH solution or in deionized water for 20 hr. On and after 0 day, the flowers were held in vase water (deionized water). Values are mean ±SE (n=5).



第 14 圖 切花 開花速度 “ 及 輸送方式 ” 影響  
 Z) : 各調查時, 點 開花 前後差  
 Y) : 20°C 輸送 (靜岡農試, 1992)



第 13 圖 切花 體內水分 及 輸送方式 影響  
 Z) : 24 時間 輸送 (靜岡農試, 1992)



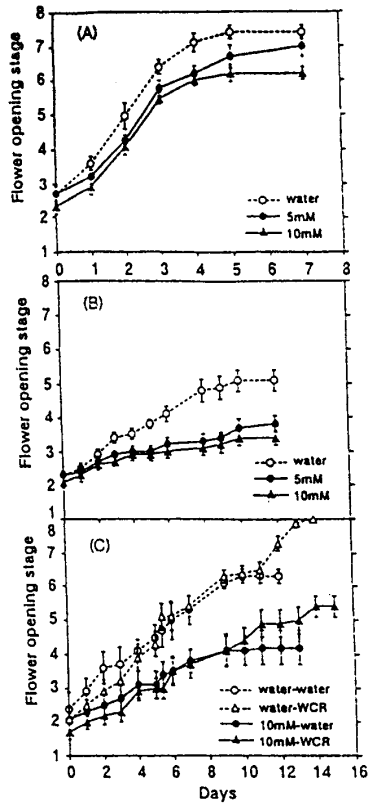


Fig. 5. Effect of PPOH pulse treatment on the opening of cut rose 'Carlred' flowers. Flowers were immersed in a 5 or 10 mM PPOH solution or in tap water for 30 hr (A), observed at 20°C; (B), observed at 10°C. (C), after PPOH pulse treatment, flowers were held in a WCR solution (triangle) or in tap water (circle) at 10°C. Values are mean±SE (n=10)

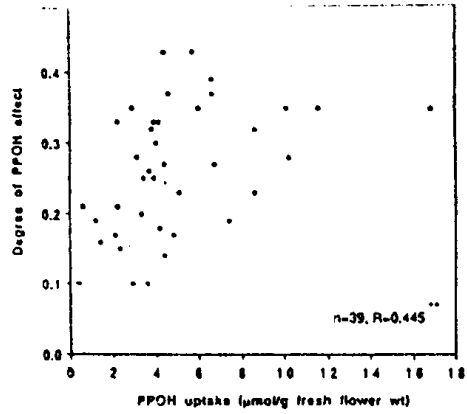
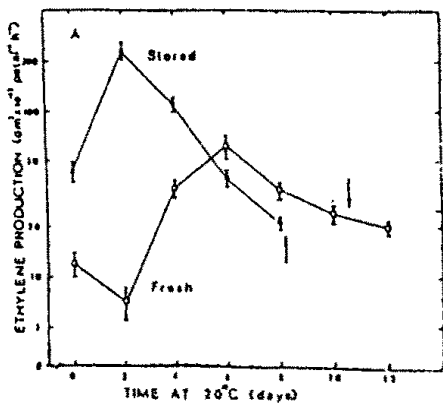


Fig. 4. Relationship between PPOH uptake into flowers and its effect on the flower opening. Values were obtained from the experiments using 'Sonia' from June 1989 to July 1990. \*\* Statistically significant at P<0.01

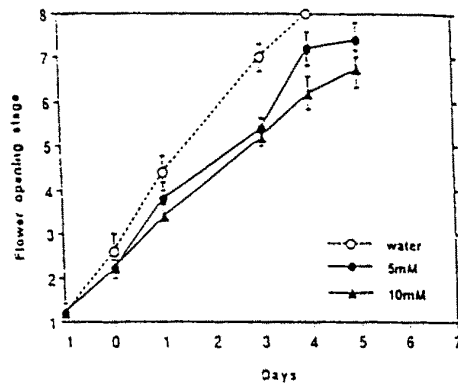
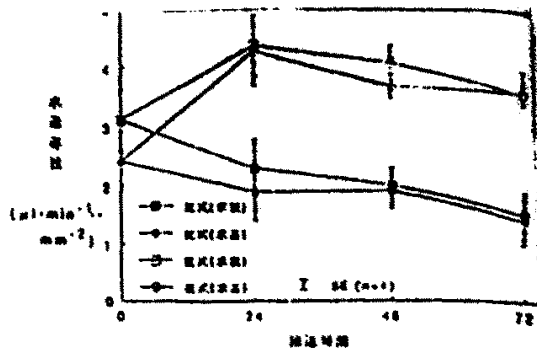


Fig. 2. Effect of PPOH pulse treatment on the opening of cut rose 'Sonia' flowers at 20°C. Flowers were immersed in a 5 or 10 mM PPOH solution or in deionized water for 20 hr. On and after 0 dya, the flowers were held in vase water (deionized water). Values are mean±SE (n=5)

Table 1. Effect of PPOH on the cumulative water uptake and transpiration loss of eat rose 'Sonia' flowers during the first 4 days.

	Water uptake (freen flower wt)	Water ross (freen flower wt)	Loss/uptake
Water	2.54=0.18 a	2.37=0.22	0.03=0.02 a
<b>PPOH</b>			
5mM	2.21=0.16 ab	2.00=0.15 ab	0.90=0.01 a
10mM	1.90=0.12 b	1.74=0.29 b	0.92=0.01 a

Table 3. Effects of 3% sucrose pulse (18 h, at 1°C), before or after storage, on the vase life and opening of 'Gabriella' rose. Values are means of 10 replicates.

Treatment	Vase life (days)	Flower diameter (mm)
<b>Sucrose effect</b>		
- sucrose	8.8	44.4
+ sucrose	9.7	44.8
LSD (p≤.05)	0.6	3.0
<b>Treatment X time effect</b>		
Before	9.0	42.2
After	9.6	47.0
LSD (p≤.05)	0.6	3.0

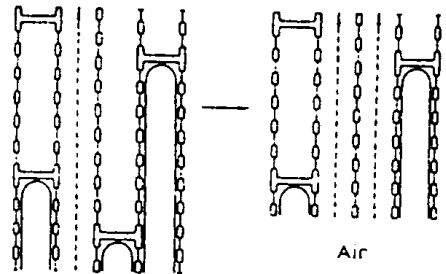
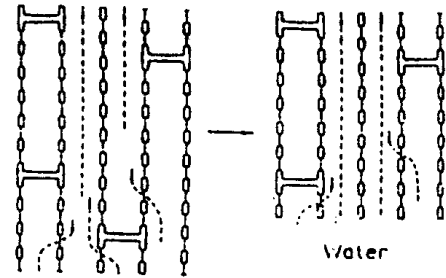


Table 3. The effect of continuous treatment of roses with preservative solution (8-HQC+S), with or without 0.5% Ca(NO<sub>3</sub>)<sub>2</sub>, on the rate of rose bud development. Rose development was evaluated by recording the development stage number daily (Fig. 1)

Treatment	Experiment duration in days										
	1	2	3	4	5	6	7	8	9	10	11
H <sub>2</sub> O	1.5	2.5	2.8	3.0	3.0						
8-HQC+S	1.6	2.1	2.8	3.0	3.2	3.5	4.0	4.0			
8-HQC+S+ Ca(NO <sub>3</sub> ) <sub>2</sub>	1.4	1.9	2.3	2.4	2.5	2.5	2.9	3.0	3.0	3.0	3.0

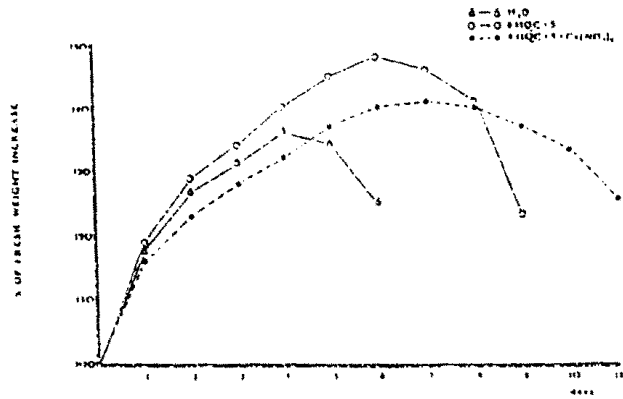


Fig. 2. Changes in fresh weight of cut roses during their continuous treatment with preservative solution (8-HQC+S) alone or enriched with 0.5% Ca(NO<sub>3</sub>)<sub>2</sub>. Vertical bar indicates SE.

Table 1. Effect of Abscisic Acid on Longevity and Opening of Cut Rose Flowers cv. Golden Wave Without Leaves

Opening index was calculated as the area of circle created by the average diameter of the flower, measured of their 2nd day in the vase. Each value is a mean of 20 flowers.

Treatments	Vase Life days	Opening Index cm <sup>2</sup>
Water Control	5.3a <sup>1</sup>	65.8b
DMSO 0.1%	5.0a	56.6b
DMSO 0.1%+ABA 100 µg/g	4.0b	156.8a
DMSO 0.1%+ABA 500 µg/g	3.2c	164.7a

<sup>1</sup>: Values followed by different letters are significantly different at P=0.05 (Duncan's multiple test).

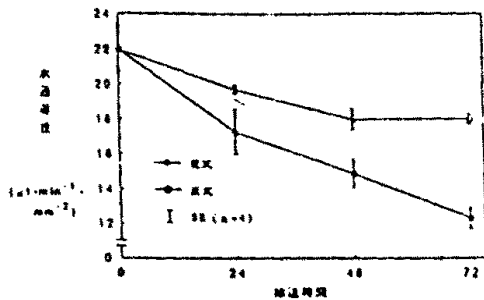


Table 5. Effect of STS (0/5 mM, 0.5 h, at 20°C) and sucrose (3%, 18h) on vase life and quality of 'Garbriella' roses after 3-week cold storage (1°C). Treatments were applied either before or after storage, in two separate experiments. Values are means of 10 replicates.

Treatment	Vase life (days)	Petal count		Flower diam (mm) Day 7
		Open	Reflexed	
<u>Before storage</u>				
Control	9.8	13.7	8.7	45.2
STS	13.2	13.2	4.6	35.3
STS+sucrose	14.3	13.7	7.8	38.3
LSD(p≤0.05)	1.0	4.5	4.1	5.4
<u>After storage</u>				
Control	11.8	13.6	5.0	51.9
STS	15.0	11.4	3.1	53.0
STS+sucrose	16.5	10.1	5.6	56.2
LSD(p≤0.05)	2.1	4.5	3.6	6.5

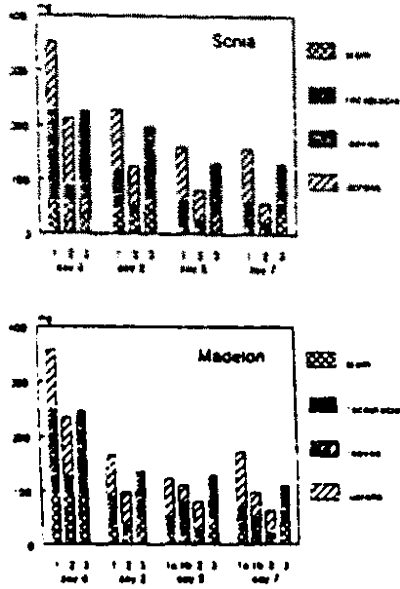


Table 1. Effect of  $Co^{2+}$  on total water uptake, total water loss and water loss/water uptake ratio in cut 'Samantha' roses.

$Co^{2+}$ concentration (mM)	Total water uptake in 8 days (g/flower)	Total water loss in 8 days (g/flower)	Water loss/water uptake ratio
0	82.7 b <sup>zy</sup>	83.2 c	1.015 a
0.5	95.6 a	95.4 a	0.991 b
1.0	85.3 b	84.0 bc	0.981 bc
1.5	96.6 a	94.3 ab	0.975 c
2.0	96.3 a	95.3 a	0.984 bc

<sup>Z</sup> Mean separation within columns by Duncan's multiple range test, 5% level

<sup>Y</sup> Values for each concentration are means of salts of cobalt.

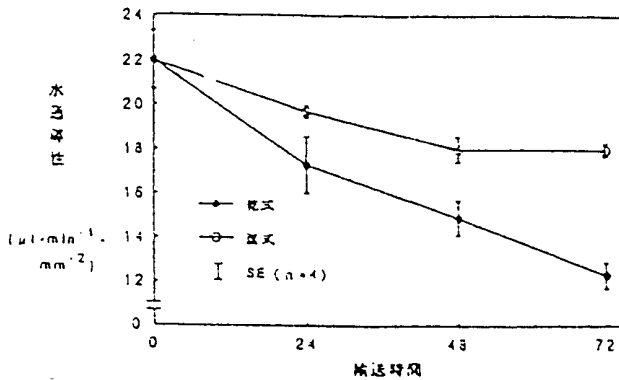
J. Amer. Soc. Hort. Sci. 105(2): 148-151. 1980

Table 1. Effects of 3 week cold storage at 1°C on vase life and quality of rose flowers cv. Gabriella. Values are means of 10 replicates.

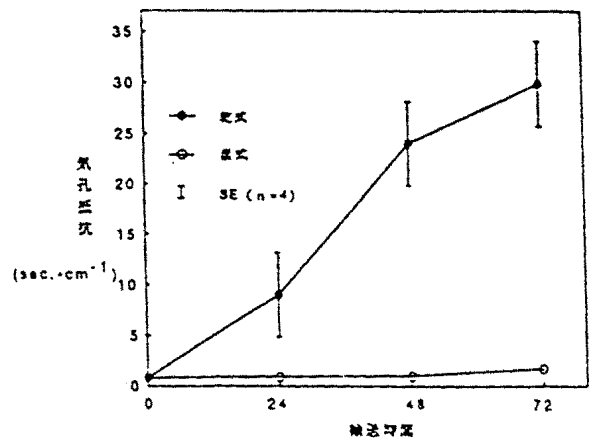
Treatment	Vase life (days)	Flower diam. (mm)	Petals	
			Open	Reflexed
Fresh	12.9	51.4	19.2	19.2
Stored	5.8	47.3	12.4	8.5
LSD (p≤0.05)	0.8	4.2	4.8	6.3

Table 1 The effect of continuous treatment with preservative solution (8-HQC+S) and calcium nitrate on flower diameter and vase life.

Treatment	Diameter (mm)	Vase life (days)
H <sub>2</sub> O	85.8 b	3.1 a
8-HQC+S	101.6 c	6.0 c
Ca(NO <sub>3</sub> ) <sub>2</sub> 0.1%	88.6 b	5.0 bc
Ca(NO <sub>3</sub> ) <sub>2</sub> 0.25%	77.4 a	6.2 c



第3圖 切花 乾式 混式輸送中 基部5cm切片 水通導性 變化。



第2圖 切花 乾式 溫式輸送中 變化 輸送方法第一圖參閱。

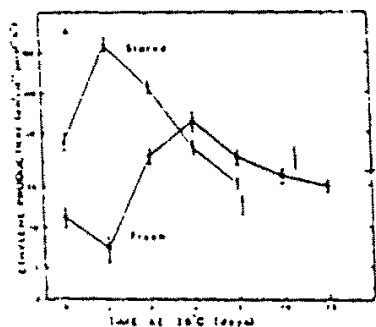


Fig.2

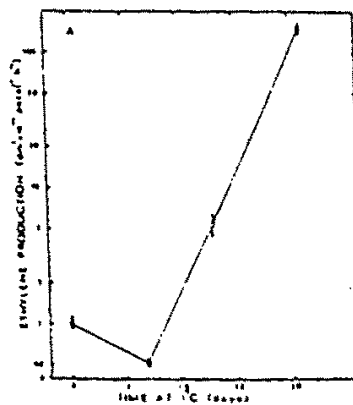


Fig.3

Fig. 2. Changes in ethylene production in petals of fresh and colostored (1°C) rose flowers. Ethylene values are means of 10 replicates S. E.. The arrows indicate the end of flower vase life (adapted from Faragher et al. 1987 a).

Fig. 3. Changes in ethylene production in rose flower petals during storage at 1°C. Ethylene production was measured at 1°C. Replicates as in Fig. 1 (adapted from Faragher et al. 1947 a).

Table 3. Effects of 3% sucrose pulse (18 h, at 1°C), before or after storage, on the vase life and opening of 'Gabriella' roses. Values are means of 10 replicates.

Treatment	Vase life (days)	Flower diameter (mm)
<u>Sucrose effect</u>		
- sucrose	8.8	44.4
+ sucrose	9.7	44.8
LSD (p≤.05)	0.6	3.0
<u>Treatment X time effect</u>		
Before	9.0	42.2
After	9.6	47.0
LSD (p≤.05)	0.6	3.0