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Effect of Maleic Hydrazide on the Vase Life of Cut Roses

Saichol Ketsa and Sajee Jaijam[1]

ABSTRACT

The effect of maleic hydrazide (MH) in a holding solution containing 8-hydroxyquinoline sulfate (HQS) and sucrose on the vase life of 'Christian Dior' cut roses was studied in relation to their water uptake, fresh weight changes, water balance, water loss, water conductivity and vascular blockage. The holding solution containing 250 mg/l HQS and 5% sucrose with optimum concentration of 400 mg/l MH increased vase life, water uptake, fresh weight and water conductivity and reduced water loss, vascular blockage as compared to the holding solution without MH. MH + sucrose was less effective than HQS + sucrose in prolonging the vase life of cut roses.

INTRODUCTION

The major factor contributing to the rapid senescence of cut rose flowers appears to be the blockage of water conducting vessels of the xylem (Burdett, 1970 ; Marousky, 1971). The stem plugging is apparently caused by several factors (Halevy and Mayak, 1981). Many studies attempted to identify the substances involved in stem plugging. Some authors demonstrated occlusions of microbial origin (Burdett, 1970). Other, however, described occlusions as pectinaceous or carbohydrate in nature (Burdett, 1970 ; Parups and Molnar, 1972), or they were composed of breakdown products of cell walls (Rasmussen and Carpenter, 1974). Lineberger and Steponkus (1976) demonstrated the existence of two types of vascular blockage in rose stem. Microbial occlusion was located at the base of cut stems, while physiological occlusion or gum deposition was found above the solution level.

The bactericide is one of the most important components in the preservative solutions to control harmful bacteria and help to prevent bacterial plugging of water conducting tissues (Halevy and Mayak, 1981). Other materials tested as preservatives include chelating agents (Kelly and Hamner, 1958), respiratory inhibitor (Larsen and Scholes, 1965), antibiotics (Wiggans and Payne, 1963), metallic salts (Reddy, 1988) and growth inhibitors (Kelly and Hamner, 1958). Sucrose is the most widely used sugar as a respiratory substrate in preservative solution for cut flower (Halevy and Mayok, 1981), MH is probably the most recommended growth inhibitor for cut flowers including carnations, chrysanthemums, lupins, roses and snapdragons (Kelly and Hamner, 1958 ; Weinstein and Laurencot, 1963 ; Ram and Rao. 1977). However, these reports have not provided evidence how MH increased the vase life of these cut flowers. Since the suitable holding solution for Christian Dior' cut roses was found to contain 250 mg/l HQS and 5% sucrose (Ketsa and Treetaruyanondha, 1989). Therefore, the standard holding solution containing 250 mg/l HQS and 5% sucrose was used in this experiment to study comparatively the effect of MH.

The aim of this study was to investigate the possible role of MH in extending the vase life of cut roses.

[1] Dept. of Horticulture, Faculty of Agriculture, Kasetsart Univ., Bangkok 10903, Thailand.

MATERIALS AND METHODS

Plant materials. Roses *(Rosa· hybrida* 'Christian Dior') obtained from a local grower were grown in the open field under natural conditions. Following harvest and transport to the laboratory within 1 hr by truck, the stems were recut slantingly to a length of 30 cm. Two uppermost compound leaves were left intact. After recording the fresh weight, each flower was placed in a 50-ml. graduated cylinder containing tap water or chemical solutions. At daily intervals, water uptake and fresh weight were measured. In addition, the following parameters were also measured.

Water balance (water uptake and water loss). Twelve 50-ml graduated cylinders containing 50-ml of tap water or chemical solutions were covered with aluminum foil and then weighed. Roses were placed through a hole in the aluminum foil into the graduated cylinders. At daily intervals, each graduated cylinder was weighed with and without the flowers. Evaporative water loss in this experiment was negligible.

Water conductivity of isolated stem segments. The water conductivity of isolated stem segments was determined using a modification of the method described by Durkin (1979). Basal end of 2.5 cm stem segments were used. Eluant from the stem segments were collected and measured, and the flow rates were calculated as ml/hr.

Vascular blockage. Cross sections of fresh and aged stems above the water or solution level approximately 30-40 um thick were cut by hand-section with a razor. The sections were allowed to soak in a saturated solution of ruthenium red for 5 min. The stained sections were washed in distilled water and examined vascular blockage under a light microscope.

Vase life. Vase life was considered to be terminated when bent neck or wilting occurred.

Twelve flowers were used for each concentration of chemical solution and each flower represented one replication. Duncan's new multiple range test was applied to check mean differences of the vase life. The buds were opened at ambient temperature with natural illumination (approximately 12 h/day). The average air temperature and relative humidity were 29.2°C and 65.1% respectively.

RESULTS

Vase life. The vase life of cut roses held in HQS+ sucrose was about twice of the control. MH increased the vase life of cut roses held in 250 mg/l HQS + 5% sucrose and their vase life reached the maximum at 400 mg/l MH, then decreased slowly (Figure 1). The effect of MH was clearly shown in Table 1. The vase life of cut rose held in HQS + sucrose + MH was longer than that held in SHQS + sucrose. Cut roses held in MH + sucrose alone had shorter was life than those held in HQS + sucrose (Table 1).

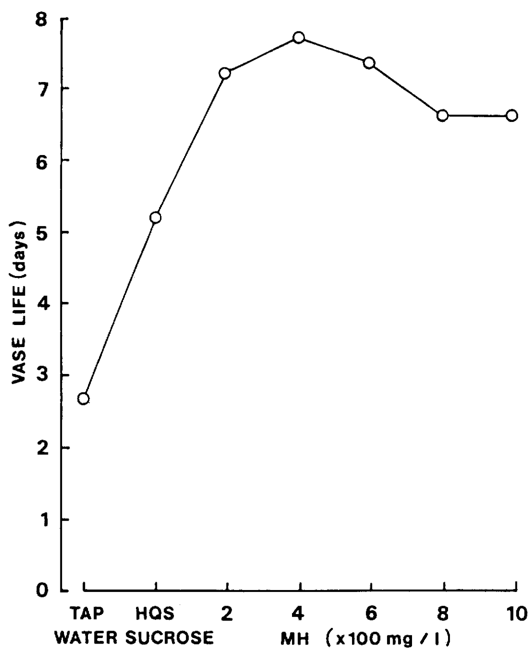

Figure 1 Vase life of cut rose held in tap water, 250 mg/l HQS + 5% sucrose and 250 mg/l HQS + 5% sucrose together with various concentrations of MH.

Table 1 Vase life of 'Christian Dior' cut roses held in tap water and various chemical solutions.

Treatment	Vas life[1] (days)
Tap water (control)	2.50 g
250 mg/l HQS + 5% sucrose + 400 mg/MH	6.25 a
250 mg/l HQS + 5% sucrose	4.50 b
400 mg/l MH + 5% sucrose	3.75 ed
250 mg/l HQS + 400 mg/l MH	3.25 3f
5% sucrose	2.75 fg
250 mg/l HQS	3.83 cd
400 mg/l MH	2.75 fg

[1] Mean within columns not sharing common letters are significantly different at the 5% level by DMRT.

Water uptake. Water uptake of cut roses held in tap water rapidly decreased after the first day, while water uptake of those held in HQS + sucrose slightly decreased for the first 3 days and thereafter rapidly decreased. Water uptake of cut roses held in HQS + sucrose + MH was greater than that held in HQS + sucrose and increased to a maximum at the third day then slowly decreased (Figure 2).

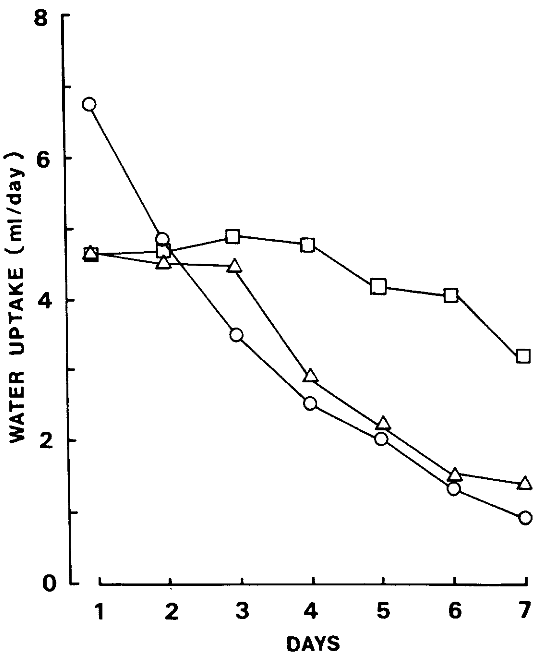

Figure 2 Water uptake of cut roses held in tap water (○), 250 mg/l HQS + 5% sucrose (△) and 250 mg/l HQS + 5% sucrose + 400 mg/l MH (□).

Fresh weight. Fresh weight of cut roses held in tap water was reached the maximum at the first day, while fresh weight of cut roses held in HQS + sucrose with and without MH reached the maximum at the second and third day respectively. Fresh weight of cut roses held

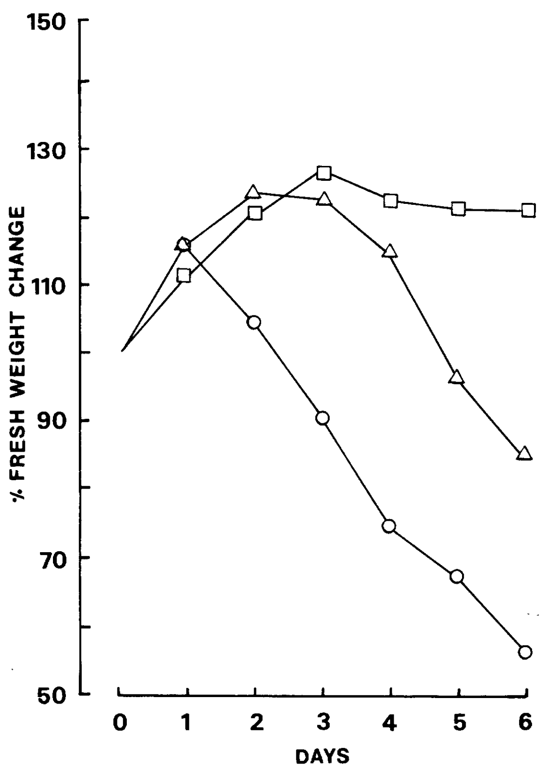

Figure 3 Fresh weight of cut roses held in tap water (○), 250 mg/l HQS + 5% sucrose (△) and 250 mg/l HQS + 5% sucrose + 400 mg/l MH (□).

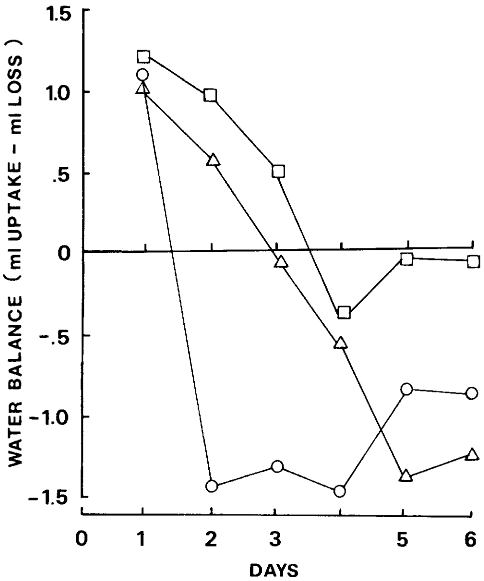

Figure 4 Water balance of cut roses held in tap water (○), 250 mg/l HQS + 5% sucrose (△) and 250 mg/l HQS + 5% sucrose + 400 mg/l MH (□).

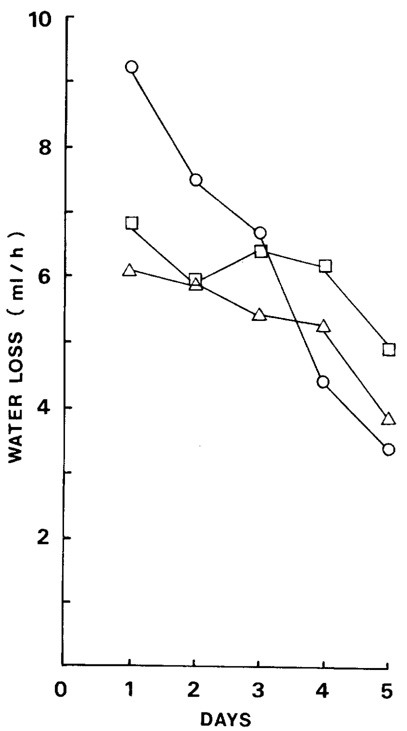

Figure 5 Water loss of cut roses held in tap water (○), 250 mg/l HQS + 5% sucrose (△) and 250 mg/l HQS + 5% sucrose + 400 mg/l MH (□).

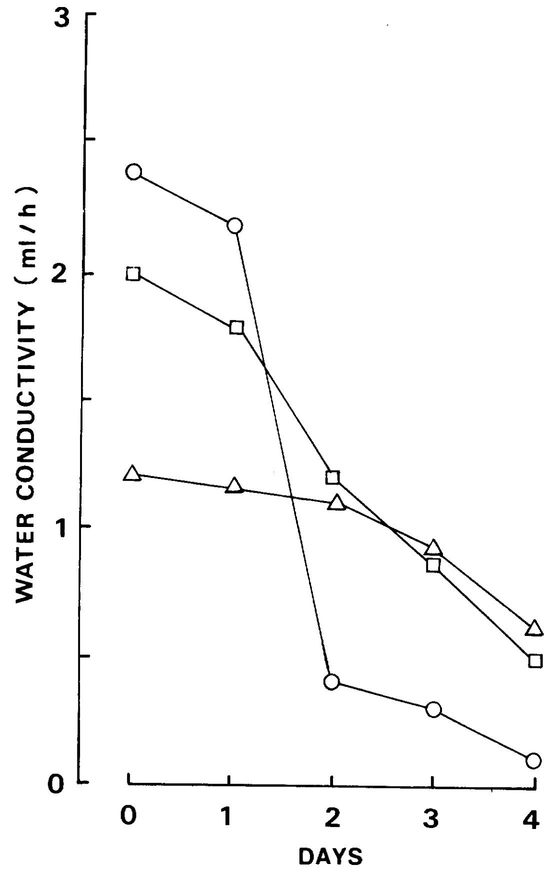

Figure 6 Water conductivity of isolated stem segments of cut roses held in tap water (○), 250 mg/l HQS + 5% sucrose (△) and 250 mg/l HQS + 5% sucrose + 400 mg/l MH (□).

in HQS + sucrose + MH decreased more slowly than those held in tap water and HQS + sucrose after reaching a maximum (Figure 3).

Water balance. Water balance of cut roses held in tap water and HQS + sucrose rapidly became negative at the second and third day respectively. In contrast, water balance of cut roses held in HQS + sucrose + MH slowly became negative at the fourth day and remained close to zero thereafter (Figure 4).

Water loss. The rate of water loss of cut roses held in tap water rapidly declined while that of cut roses held in HQS + sucrose with and without MH slowly declined. But the rate of water loss of cut roses held in HQS + sucrose declined more rapidly than those held HQS +

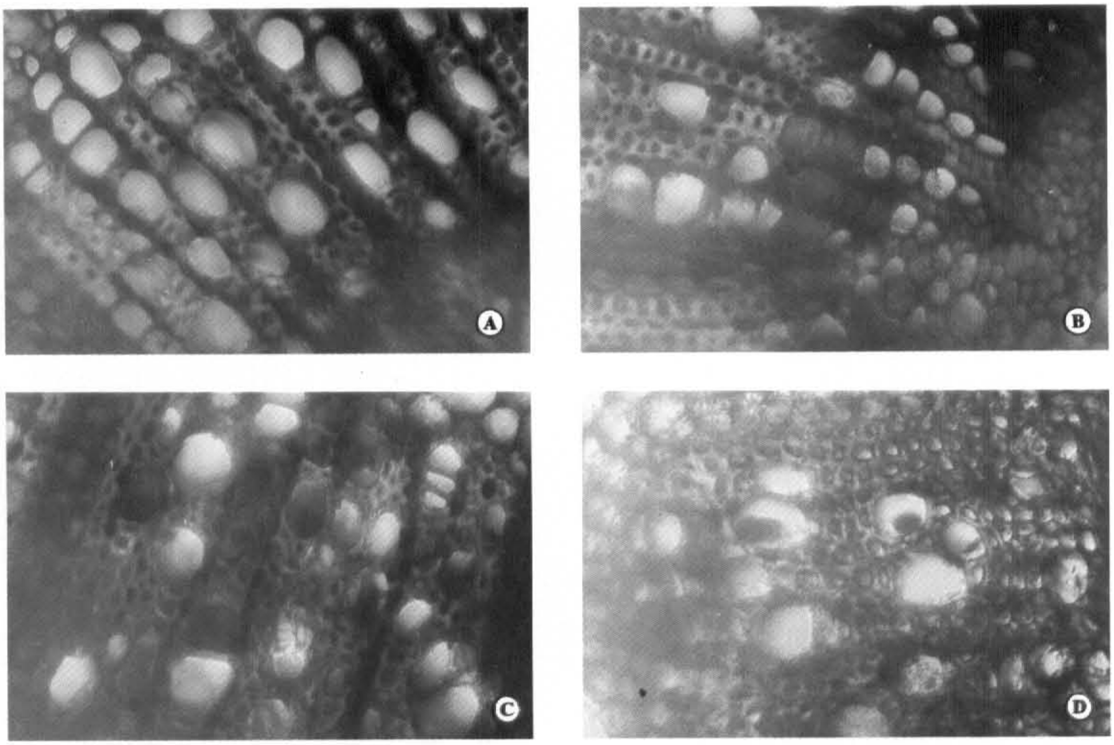

Figure 7 **Cross sections of the rose stem stained with ruthenium red (V×660) : a, freshly cut rose stem ; b, rose stem held in tap water for six days ; c. rose stem held in 250 mg/l HQS + 5% sucrose for six days ; d. rose stem held in 250 mg/l HQS +5% sucrose + 400 mg/l MH for six days. Red staining indicated occlusions of vessels containing pectin.**

sucrose + MH (Figure 5).

Water conductivity. The water conductivity of 2.5 cm stem segment of cut roses held in tap water rapidly declined after the first day. Similarly, the water conductivity of cut roses held in 250 mg/l HQS + 5% sucrose with and without MH rapidly declined. The water conductivity of cut roses held in HQS + sucrose declined more rapidly than those held in HQS + sucrose + MH (Figure 6).

Vascular blockage. The difference in vascular blockage from examination of cross sections of rose stems held in tap water, HQS + sucrose and HQS + sucrose + MH was clearly showed at the sixth day. The occlusions of xylem vessel was the most in tap water and the least in HQS + sucrose + MH (Figure 7).

DISCUSSION

The data reported here provide good evidence that MH had an additive effect in prolonging vase life of cut roses when it was used together with HQS and sucrose. MH helped HQS to reduce the vascular blockage in the rose stems (Figure 7). The additive effect on inhibition xylem blockage by MH was further evidenced by maintenance of higher water flow through the isolated stem segments obtained from cut roses held in HQS + sucrose + MH (Figures 6). Since the free-hand sections in this experiment came from rose stems above the level of tap water and solution. Thus it suggests that physiological vascular blockage may exist in rose stems (Lineberger and Steponkus, 1976). Ruthenium red stained the xylem plug red (Figure 7). Since this test may be considered rather specific for pectin or pectin-like compounds (Jensen, 1962). Therefore, occluding material in vessels may contain pectin (Parup and Molnar, 1972 ; Fujino *et al.*, 1983). HQS reduced the vascular blockage of rose stems above the solution level in this experiment. Thus HQS may have another function in prevention of physioiogical blockage other than that of a bactericide only (Marousky, 1980). Since MH helped HQS to reduce vascular blockage of rose stems held in HQS + sucrose + MH. Thus, it seems reasonable to suggest that the additive effect of MH on the vase life of 'Christian Dior' cut roses may operate through an inhibition of the development of physiological vascular blockage. At the present, in is not yet known how MH exerts its effects on the inhibition of physiological vascular blockage.

The improved water balance brought about by MH (Figure 4) resulted in increased fresh weight (Figure 3). Our data indicated that MH acts both by reducing the rate of water loss from the leaves (Figure 5) and by maintenance their water uptake (Figure 2). It thus appears that MH itself may exert some effect on the aperture of the stomatates. Since the rate at which the rapid decline in water conduction of isolated stem segments was much reduced by the presence of MH (Figure 6), it also appears that much of the MH effect is due to maintenance of the water supply.

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