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Effects of Cultivation Method and Preservative Solution on the Vase Life of Cut Rose 'Rote Rose'

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Abstract. Experiments were conducted to evaluate quality and vase life of cut rose 'Rote Rose' cultivated either in soil or hydroponically in rockwool. Rose stems were put in four different preservative solutions, 0.5% chrysal RVB, BS (2% sucrose + 200 mg·L^{-1} 8HQS + 0.3% Chrysal RVB), Sonk1 (BS + 0.1 mM ethionine), and double distilled H_2O. Flower stems were displayed at 20 ± 1°C, RH 60%, and light intensity of 8.1 μmol·m^{-2}·s^{-1} provided by fluorescent lamps for 16 h·d^{-1}. Fresh weight and flower diameter during vase life were affected by cultivation method and were greater in hydroponically-grown roses than in soil-grown roses. Among preservative solutions, BS and Sonk1 were superior to Chrysal RVB in terms of extending vase life. Vase life of cut rose in Chrysal RVB, BS, and Sonk1 over the control was prolonged by about one day.

Additional keywords : hydroponics, fresh weight, stem length, flower diameter

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Introduction

Vase life of cut roses is influenced by various factors such as cultivation method in production, and temperature, environmental condition and preservative solution after harvest (Ueyama and Ichimura, 1998). Cut roses are produced by soil and hydroponic cultures in Korea. The area of cut rose production was estimated to be greater than 700 ha in 2002. Most of the current production is based on soil cultivation which is estimated to be about 600 ha, whereas hydroponic cultivation is only about 100 ha.

Growers claim that cut roses produced by soil cultivation have thinner stems and a shorter mean stem length as compared to those produced hydroponically. Hydroponic cultivation also enables rapid growth and increased flower yield, by adjusting rhizosphere environmental conditions to optimum for the growth, and production of more exportable high quality stems per unit production area (Cho et al., 2001; Lee, 1983; Son et al., 1998).

Cut rose flowers wilt and the floral axis becomes bent just below the flower head (bent neck) after harvest. The development of such symptoms is considered to be the result of the vascular occlusion, which inhibits water conduction through the stem to the flower (de Stigter, 1981; Mayak and Halevy, 1974; van Doorn and de Witte, 1997). The development of occlusions is thought to be caused by various factors, such as bacteria (Burdett, 1970; Jones and Hill, 1993; van Doorn et al., 1991; Zagory and Reid, 1986), air embolism (Durkin, 1979; van Doorn, 1989) and physiological responses of stems to cutting (Marousky, 1969). Clerks and Boekestein (1989) and van Doorn et al. (1991) observed by electron microscopy and identified many bacteria in cut rose stems. These findings suggest that vascular occlusion can indeed be caused by bacteria leading to shortening of the vase life of cut rose flowers. This view is supported by the findings that continuous treatment with 0.5% chrysal RVB (Pokon & Chrysal, the Netherlands), BS (2% sucrose + 200 mg·L^{-1} 8HQS + 0.3% Chrysal RVB), and Sonk1 (BS + 0.1 mM ethionine; Son et al., 1997), effective germicides, extended the vase life of cut rose flowers. In this study, we investigated the effects of cultivation method (hydroponic vs. soil cultivation) and preservative solution of cut roses on the vase life of cut rose 'Rote Rose'.

Table 1. The chemicals and their concentrations used in the nutrient solution for the culture of cut rose cv. 'Rote Rose'.

Formula	Conc. ($mg \cdot L^{-1}$)	Formula	Conc. ($mg \cdot L^{-1}$)
$5[Ca(NO_3)_2 \cdot 2H_2O]NH_4NO_3$	669.6	Fe-EDTA	15.00
$MgSO_4 \cdot 7H_2O$	246.0	H_3BO_3	1.40
KNO_3	272.7	$MnSO_4 \cdot 4H_2O$	2.10
NH_4NO_3	112.0	$NaMoO_4 \cdot 2H_2O$	0.12
KH_2PO_4	163.2	$ZnSO_4 \cdot 7H_2O$	0.86
K_2SO_4	60.9	$CuSO_4 \cdot 5H_2O$	0.20

Materials and Methods

Plant materials

Cut roses (*Rosa hybrida* L. 'Rote Rose') cultivated either in soil or hydroponically in rockwool slabs were used in the present study. Both hydroponically-grown and soil-grown crops were supplied with a nutrient solution formulated by the Japanese Horticultural Research Station as shown in Table 1. In both growing systems, crops were grown in glasshouses under 240 $\mu mol \cdot m^{-2} \cdot s^{-1}$ PPFD (on sunny days). Flowering stems of selected length of 50~60 cm were harvested early in the morning on November 11, 1998 and were packed after wrapping stem ends in a wet newspaper. Rose flower stems harvested in commercial greenhouses in Kimhae were transported for about two hours to the floricultural laboratory at Gyeongsang National University. Upon arrival, stem ends were recut under the tap water to a uniform stem length of 45 cm and leaves below third trifoliolate leaf were removed.

Preservative solutions

One cut flower stem was placed in each 200 mL mess-cylinder filled with 200 mL distilled water (control), 0.5% Chrysal RVB (Pokon & Chrysal, the Netherlands), BS [2% sucrose + 200 $mg \cdot L^{-1}$ 8HQS (8-hydroxyquinoline sulfate) + 0.3% Chrysal RVB], or Sonk1 (BS + 0.1 mM ethionine; Son et al., 1997) (Cho et al., 2001).

Environmental conditions

Ten cut flower stem were used for each replication and each treatment had three replicates placed in a randomized design an environment-controlled room at 20 ± 1°C under 60% relative humidity. A 16 h per day photoperiod was maintained with 8.1 $\mu mol \cdot m^{-2} \cdot s^{-1}$ light from fluorescent lamps (Philips TL33). Cut flowers were placed at a 10 cm × 10 cm density.

Methods of measurements

Vase life in days, fresh weight of cut flower, flower diameter, and the amount of water uptake were measured daily at noon. Vase life was the period from the time of harvest to the time when either one of following: the flower became excessively opened, the neck became bent, flower stopped opening, petals abscised, the petal color showed bluing, or petal withered. The fresh weight was measured by an electronic balance (GB 3002, Mettler Toledo, Switzerland). Flower diameter was measured for a maximum flower diameter by a vernier caliper. The amount of solution uptake was calculated by dividing daily solution consumption (in g) by the fresh weight (in g) of the flower.

Results

Vase life

Among all preservative solutions tested, the treatment of double distilled water (control) showed the shortest vase life of cut flowers (Table 2). The BS treatment was superior to other treatments in extending vase life. The BS treatment to hydroponically-grown roses gave the longest vase life among all treatments tested. No differences were observed between soil cultivation and hydroponic cultivation in vase life in treatments other than the BS treatment (Table 2). The BS treatment prolonged vase life for one to two additional days as compared to other treatments. Even though the BS and the Sonk1 treatment extended vase life, the BS was much more effective than the Sonk1 in both cultivation methods.

Fresh weight, flower diameter, and solution uptake

Fresh weight of cut flowers in all treatment solutions

Table 2. Effect of cultivation method and preservative solution on vase life (in days) of cut rose 'Rote Rose' harvested on Nov. 1 and displayed at 20°C.

Preservative solution	Cultivation method		
	Hydroponics	Soil	Mean
Double distilled water (Control)	4.97 c[z]	4.90 c	4.93 c
0.5% Chrysal RVB	5.50 b	5.67 b	5.58 b
BS[y]	6.47 a	5.97 a	6.22 a
Sonk1[x]	6.00 ab	5.73 ab	5.87 b

[z]Mean separation within columns by Duncan's multiple range test at 5% level.
[y]2% sucrose + 200 mg·L^{-1} 8HQS (8-hydroxyquinoline sulfate) + 0.3% Chrysal RVB.
[x]BS + 0.1 mM ethionine.

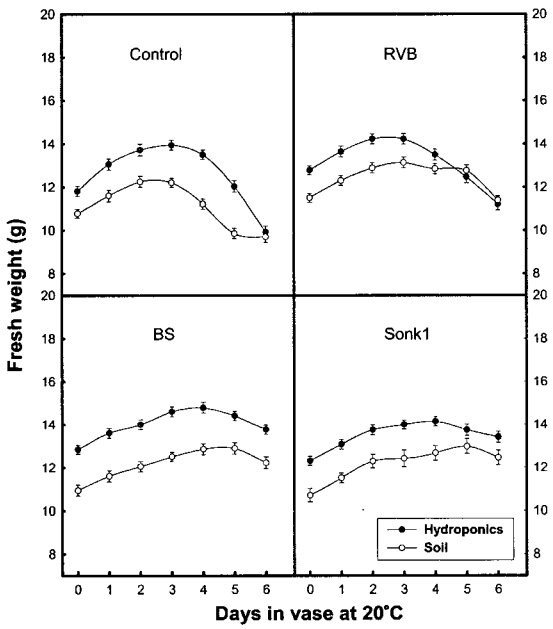

Fig. 1. Changes in fresh weight of cut rose 'Rote Rose' held in different preservative solutions at 20°C. Chrysal RVB, 0.5% Chrysal RVB; BS, 2% sucrose + 200 ppm 8HQS + 0.3% Chrysal RVB; and Sonk1, BS + 0.1 mM ethionine. Flowers were harvested on Nov. 1. Values are means of ten flowers. The vertical bars indicate standard errors.

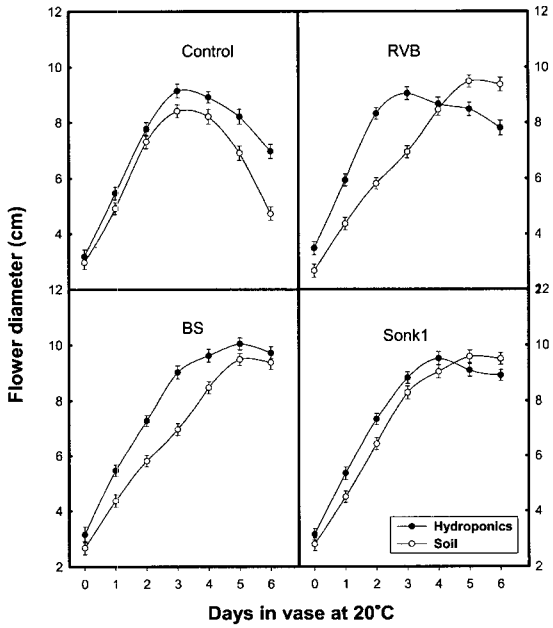

Fig. 2. Changes in flower diameter of cut rose 'Rote Rose' held in different preservative solutions at 20°C. Chrysal RVB, 0.5% Chrysal RVB; BS, 2% sucrose + 200 ppm 8HQS + 0.3% Chrysal RVB; and Sonk1, BS + 0.1 mM ethionine. Flowers were harvested on Nov. 1. Values are means of ten flowers. The vertical bars indicate standard errors.

increased over the first 3~4 days of the experiment, and decreased thereafter (Fig. 1). The maximum fresh weight during vase life experiment of cut flowers produced hydroponically showed no significant differences among preservative solution treatments (Fig. 1).

Among all treatments, the flower diameter was the greatest in the BS, but was not statistically significant (Fig. 2). Flower diameter of cut flowers in all treatments increased over the first 3 to 4 days of the experiment, and decreased thereafter (Fig. 2). The greatest flower diameter was obtained in the BS treatment of hydroponically-grown roses.

Solution uptake markedly increased over the first 1 to 2 days, and then rapidly decreased in both cultivation methods and in all preservative solution treatments (Fig. 3).

Discussion

The vase life of cut rose flowers was longer in the BS solution and in hydroponically-grown roses. Vase life

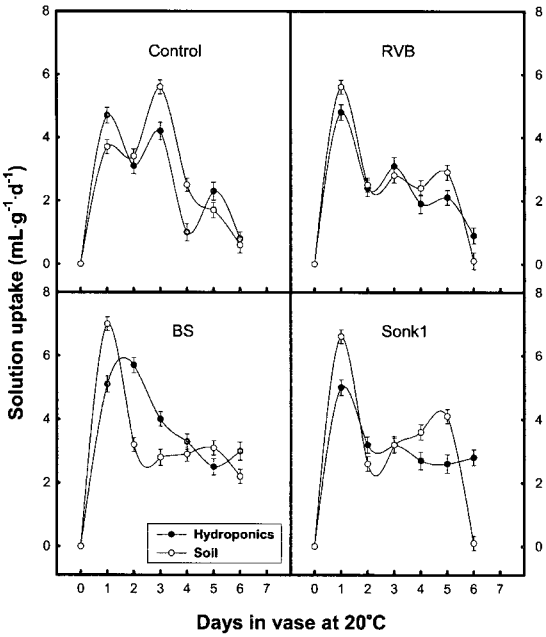

Fig. 3. Changes in solution uptake by of cut rose 'Rote Rose' held in different preservative solutions at 20°C. Chrysal RVB, 0.5% Chrysal RVB; BS, 2% sucrose + 200 ppm 8HQS + 0.3% Chrysal RVB; and Sonk1, BS + 0.1 mM ethionine. Flowers were harvested on Nov. 1. Values are means of ten flowers. The vertical bars indicate standard errors.

was the longest in the BS treatment, suggesting that the BS solution probably inhibits vascular occlusion most effectively (Table 2) and similar results have been reported by Burdett (1970). The development of vascular occlusion is correlated with the growth of bacteria at the cut stem surface and inside the stem (van Doorn et al., 1991). Addition of bacteria to vase water shortened the vase life of cut rose flowers (Zagory and Reid, 1986). Thus, inhibition of vascular occlusion by the BS solution might be attributed to its germicidal action.

Between the two cultivation methods, fresh weight and flower diameter of cut flowers were greater in hydroponically-grown roses than in soil-grown roses (Figs. 1 and 2). Solution uptake during the first day markedly increased and then drastically decreased thereafter in all treatments (Fig. 3) which is in agreement with the results of Marousky (1969) and de Stigter (1981). Kuc and Workman (1964) found that stomata were closed when petioles of chrysanthemum leaves were placed in 2,000 mg·L^{-1} 8HQS. However, as described by van Doorn and de Witte (1997), this concentration was ten times higher than that used in vase solution in the current flower trade. In this study, solution uptake was not inhibited much by the BS solution (Fig. 3). Thus, the effect of the BS solution on stomatal closure seemed to be negligible.

적 요

본 실험은 토양재배와 양액재배 방식으로 생산된 절화장미 '롯데로제'의 품질과 절화수명의 차이를 알아보기 위해 수행되었다. 절화장미를 0.5% Chrysal RVB, BS (2% sucrose + 200 mg·L^{-1} 8HQS + 0.3% Chrysal RVB), Sonk1 (BS + 0.1 mM ethionine)의 3종류 보존용액과 대조구로서 2차 증류수에 꽂아 두고 조사하였다. 수명을 조사하기 위해 절화장미를 유지한 환경제어실은 온도 20 ± 1°C, 상대습도 60%, 그리고 광도 8.1 μmol·m^{-2}·s^{-1} (광주기 일일 16시간, 형광등)의 조건을 갖추고 있었다. 생체중과 화경장은 재배방법에 의해 영향을 받았고, 토양재배한 장미에서보다 양액재배한 장미에서 절화수명이 유의성 있게 길었다. 보존용액 중에서는 BS와 Sonk1 용액에서 Chrysal RVB 용액에서 보다 절화수명이 유의성 있게 더 길었다. 또한 Chrysal RVB, BS, 또는 Sonk1을 처리한 장미의 절화수명은 대조구에 비해 1일 이상 연장되었다.

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