温度と硫酸アルミニウムがバラ切り花の品質保持に及ぼす影響

誌名	野菜･茶業試験場研究報告
ISSN	13432206
著者	市村, 一雄 上山, 茂文
巻/号	13号
掲載ページ	p. 51-60
発行年月	1998年3月

Effects of Temperature and Application of Aluminum Sulfate on the Postharvest Life of Cut Rose Flowers

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(Received for Publication August 1, 1997)

Synopsis

Effects of temperatures, 20, 22.5, 25, 27.5 and 30℃ and continuous application of aluminum sulfate on the postharvest life of rose (*Rosa hybrida* L.) cv. Sonia were investigated. Regardless of aluminum sulfate treatment, flower opening was accelerated by the increase of the temperature. The vase life of the flowers was shorter when the temperature was higher. Aluminum sulfate extended the vase life at all the temperatures examined, particularly at 25℃. Fresh weight of cut flowers once increased and thereafter decreased. Fresh weight decrease started earlier when the temperature was higher. Water uptake of cut flowers decreased with time at all the temperatures except at 20℃. Aluminum sulfate inhibited water loss and maintained water uptake.

These results indicate that the postharvest life of cut rose flowers is markedly affected by the temperature. It is also suggested that the use of aluminum sulfate is effective in extending the postharvest life by improving water relations.

Key Words : *Rose hybrida*, cut flower, postharvest life, water relation, aluminum sulfate, temperature

I Introduction

Postharvest life of cut rose flowers is often very short and life end is expressed by water stress symptoms such as wilting and bending of the stem segment just below the flower head (referred to as bent-neck). The development of these symptoms is attributed to vascular occlusion which inhibits water transport in the stem (Mayak et al., 1974 ; De Stigter, 1980; Van Doorn, 1997). Vascular occlusion is considered to be associated with some factors such as bacterial proliferation (Burdett, 1970; Zagory and Reid, 1986; Van Doorn et al., 1989; Jones and Hill, 1993), air emboli (Durkin, 1979; Van Doorn, 1990) and physiological processes in stems as a response to cutting (Marousky, 1969). In an electronmicroscopic study, Clerkx et al. (1989) observed the presence of bacteria in the rose stem. Furthermore, Van Doorn et al. (1989) reported that there was a positive correlation between the number of bacteria and water conductivity of stem. These findings suggest that vascular occlusion may be caused by bacterial proliferation, leading to the shortening of the vase life of cut rose flowers. Actually, continuous treatment with some germicides such as silver nitrate or 8-hydroxyquinoline sulfate has been shown to extend the vase life of cut rose flowers (Burdett, 1970; Gilman and Steponkus, 1972; Goszczynska and Rudnicki, 1988; Van Doorn et al., 1990; Jones and Hill, 1993). In addition to water relations, sugars are also involved in the short vase life of cut roses because sugar sources of cut flowers are limited. This assumption is

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supported by the finding that the addition of sugars such as sucrose to vase water extends the postharvest life of rose (Marousky, 1969; Gilman and Steponkus, 1972; Parups and Chan, 1973; Kaltaler and Steponkus, 1976).

The postharvest life of cut roses was also found to be markedly affected by the temperature. Uda et al. (1995) reported that the vase life of cut roses became shorter when the temperature was higher (5, 15, 25 and 35℃). However, the effect of moderate temperatures under living environment such as 20 to 30℃ on the postharvest life of cut roses has not yet been investigated in detail.

Aluminum sulfate, an effective germicide, has also been found to extend the postharvest life of cut rose flowers by improving water relations (De Stigter, 1981; Put et al., 1992). To determine to what extent the temperature affected water relations involved in postharvest life, in the current study, we investigated the effects of temperature and application of aluminum sulfate on the postharvest life of cut rose flowers.

II Materials and Methods

1. Plant material

Rose (*Rosa hybrida* L.) plants cv. Sonia were obtained from a commercial grower in Ano town in Mie prefecture in December 1995. After harvest, cut ends of flower stems were immersed in tap water for 1-2 hr. The cut flowers were then transported under dry conditions to the laboratory and used for further experiments within 1 hr.

2. Treatment

Individual cut flowers were recut to 40cm. The leaves in the upper three portions were retained. Three cut flowers were transferred to a 500-mℓ beaker with 500 mℓ of distilled water (control) or 100 mg/ℓ^{-1} aluminum sulfate solution. The cut flowers were then transferred to temperature-controlled chambers (LIB-301, Iwaki

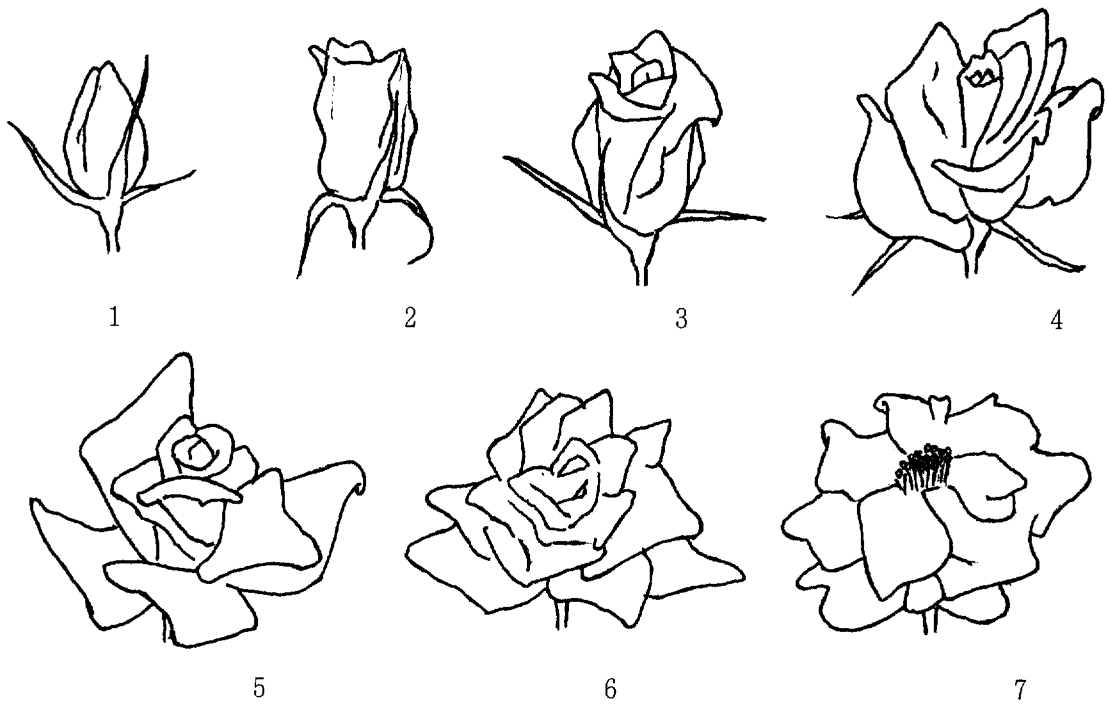

Fig. 1 Stages of flower opening

Glass Co., Ltd., Tokyo) at 20, 22.5, 25, 27.5 and 30℃ under a 12-h photoperiod with a light intensity of 10 μ mol m^{-2} s^{-1} provided by cool fluorescence lamps. Occurrence of bent-neck and degree of flower opening were observed daily. Degree of flower opening was determined according to the standards described by Uda et al. (1989) as shown in Fig. 1. Fresh weight of flower and amount of water uptake were also measured daily. Amount of water uptake was corrected by subtracting the amount of water evaporated in a beaker without cut flowers. Amount of water loss was determined by subtracting the increase of fresh weight from the amount of water uptake. Water uptake and loss were expressed as amounts of values per fresh weight of cut flowers just before the treatments. Vase life of cut flowers was considered to end when petals or the stem segment below the flower head had lost turgor or when petals had dropped, whichever occurred first.

Ⅲ Results

1. Effect of temperature and application of aluminum sulfate on flower opening and vase life of cut flowers

As shown in Fig. 2, flower opening was accelerated with the increase of the temperature regardless of aluminum sulfate treatment. Treatment with aluminum sulfate slightly accelerated flower opening.

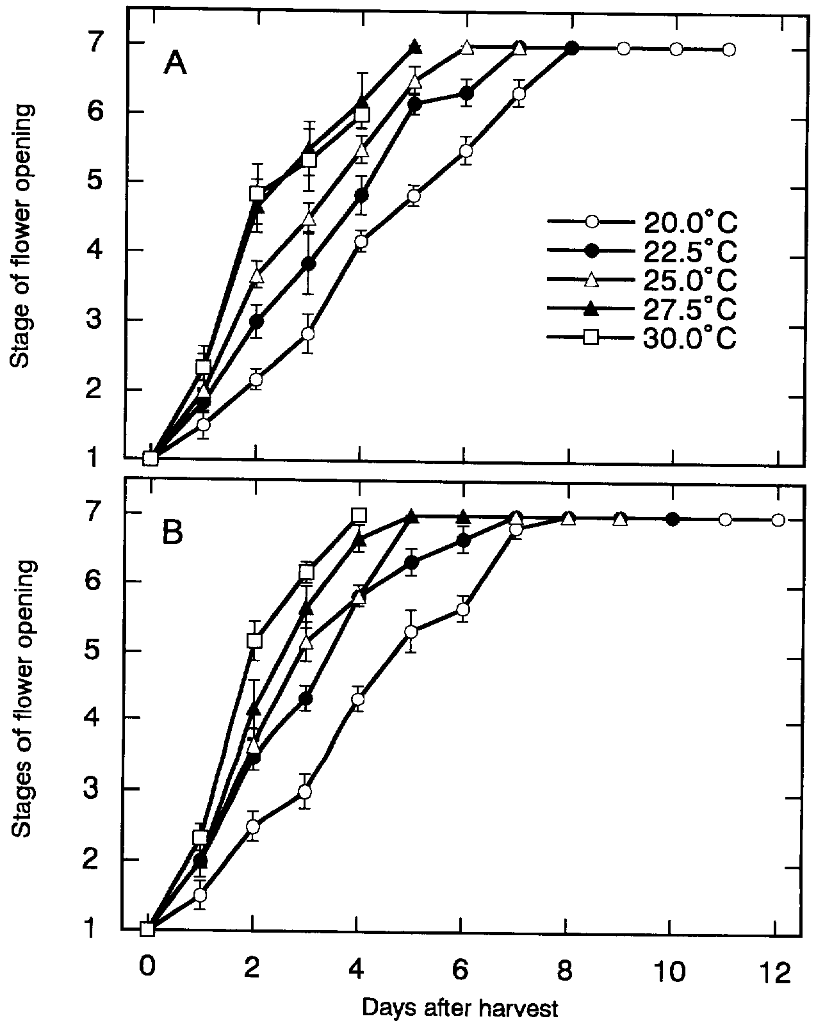

Fig. 2 Effects of temperatures and application of aluminum sulfate on flower opening of cut rose flowers. Cut flowers were treated with distlled water (A) and aluminum sulfate solution (B). Values are means of 6 replications ± standard errors.

Fig. 3 shows the effects of the temperature and application of aluminum sulfate on the vase life. Vase life of cut flowers was shorter when the temperature was higher. Control flowers wilted within 3 days and did not open fully at 30℃ whereas the vase life of the control flowers was relatively long at 20℃ (10 days). Continuous treatment with aluminum sulfate extended the vase life at all the temperatures examined. The effect on the extension of the vase life was most pronounced at 25℃. As shown in Fig.4, bent-neck occurred more frequently when the temperature was higher in the control flowers. Aluminum sulfate treatment markedly inhibited the

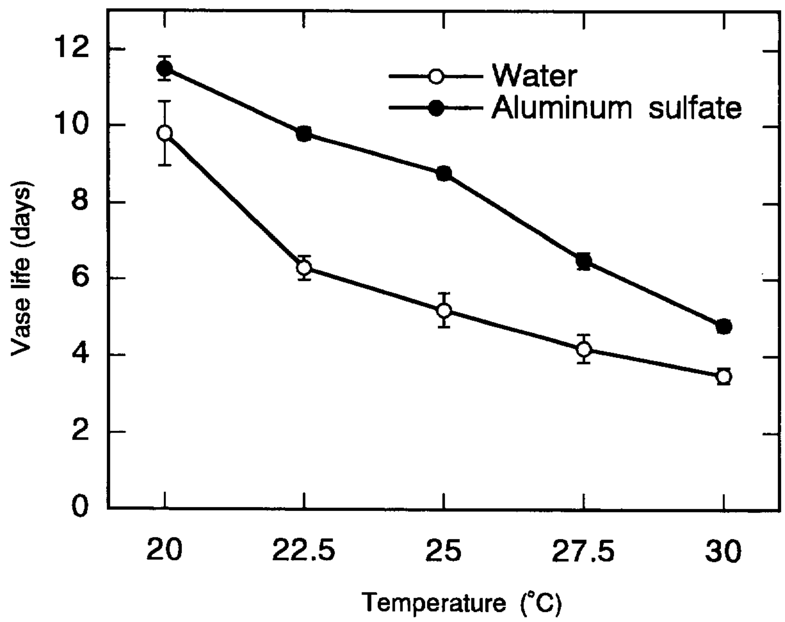

Fig. 3 Effects of temperatures and application of aluminum sulfate on the vase life of cut rose flowers. Values are means of 6 replications ± standard errors.

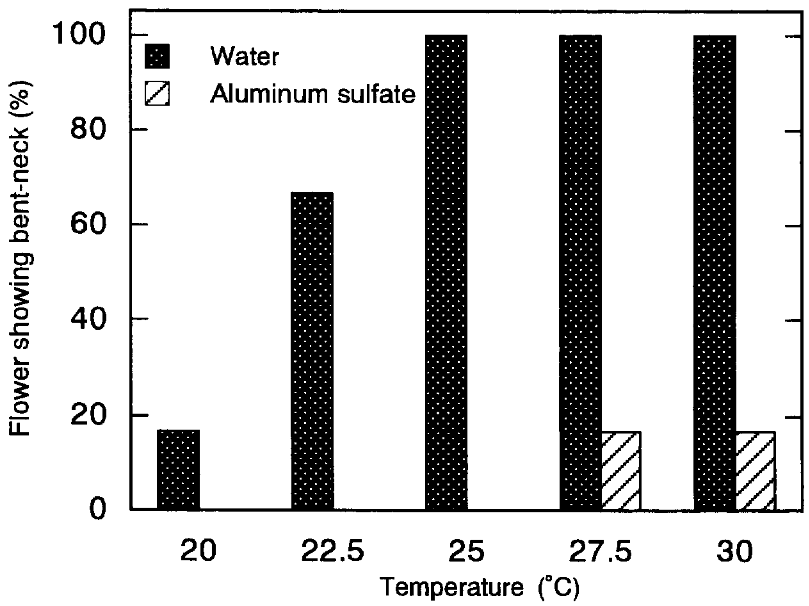

Fig. 4 Effects of temperatures and application of aluminum sulfate on flowers showing bent-neck in cut roses. Data are taken from 6 flowers.

occurrence of bent-neck at all the temperatures examined.

2. Effect of temperature and application of aluminum sulfate on fresh weight and water uptake of cut flowers

As shown in Fig. 5, fresh weight of cut flowers treated with both distilled water and aluminum sulfate once increased and thereafter decreased. Regardless of the treatment, the fresh weight reached its peak earlier when the temperature was higher. The maximum fresh weight tended to be greater when the temperature was lower in cut flowers. The continuous treatment with aluminum sulfate extended the time when the onset of fresh weight decreased by one day at all the temperatures.

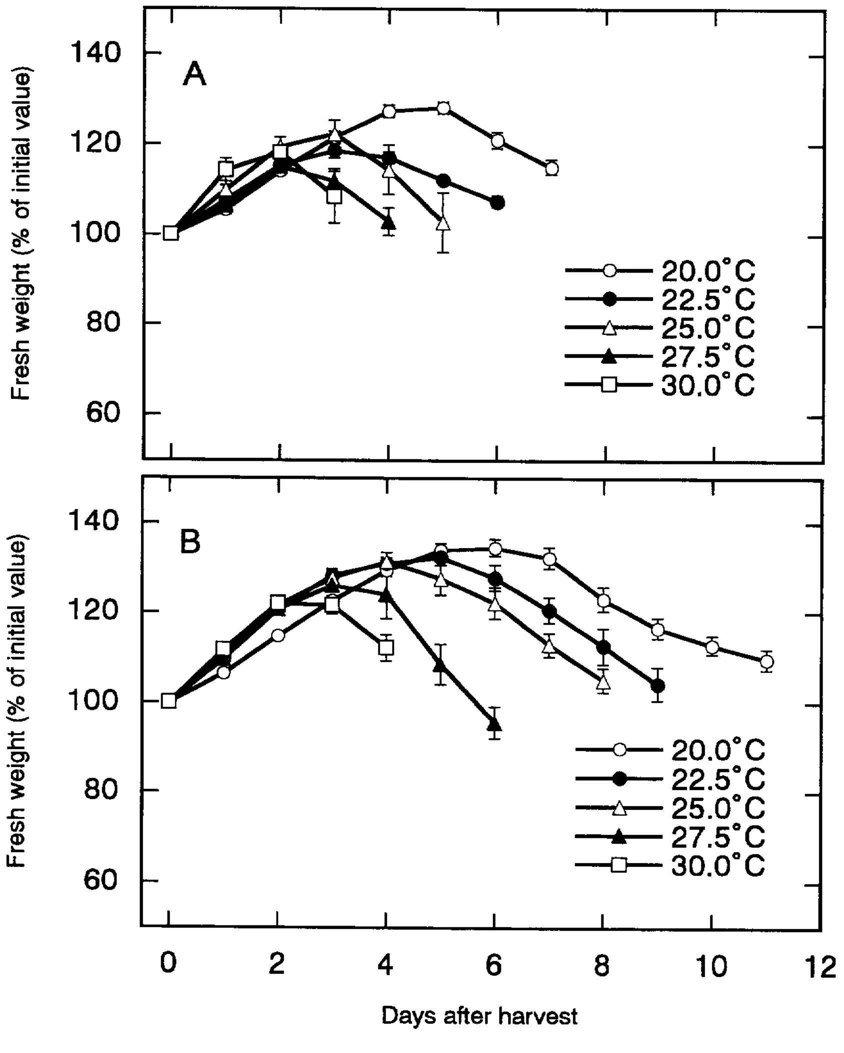

Fig. 5 Effects of temperatures and application of aluminum sulfate on fresh weight of cut rose flowers. Cut flowers were treated with distlled water (A) and aluminum sulfate solution (B). Values are means of 6 replications ± standard errors.

Fig. 6 shows the effects of the temperature and application of aluminum sulfate on the water uptake of cut rose flowers. During the first day, the water uptake was greater when the temperature was higher in cut flowers treated with distilled water. The amount of water uptake decreased with time at all the temperatures except at 20℃ at which the rate of water uptake remained high. Similarly, the water uptake of cut flowers treated with

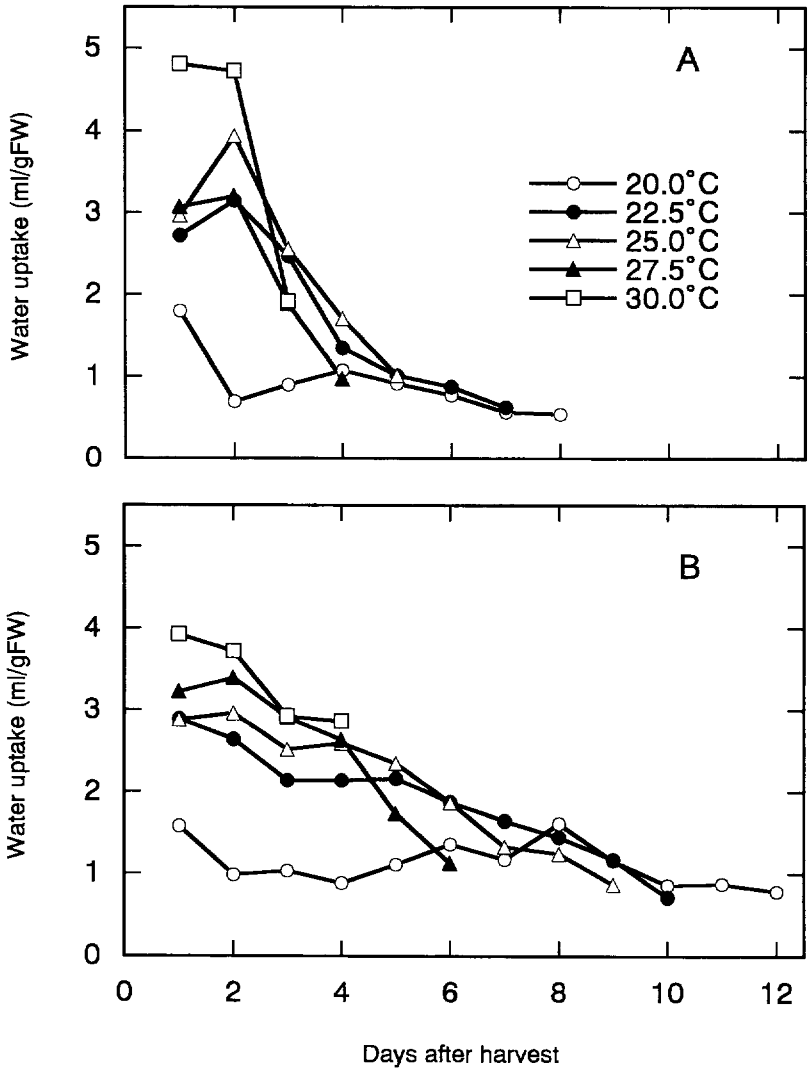

Fig. 6 Effects of temperatures and application of aluminum sulfate on water uptake of cut rose flowers. Cut flowers were treated with distlled water (A) and aluminum sulfate solution (B). Values are means of duplicate experiments.

aluminum sulfate decreased with time.

Changes in water loss were almost the same as those of water uptake. Within 2 days after harvest, the amount of water loss from cut flowers treated with aluminum sulfate was lower than that of control flowers at all the temperatures except at 20℃, suggesting that aluminum sulfate inhibits the transpiration (Fig. 7).

Ⅳ Discussion

When the temperature was higher, not only the postharvest life was shorter but also the rate of flower opening increased (Figs. 2 and 3). These results are consistent with those reported by Uda et al. (1995) although the temperatures used were 5, 15, 25 and 35℃. Vase life of cut flowers treated with distilled water sharply decreased when the temperature was higher than 20℃. To keep the quality without using a preservative, therefore, cut rose flowers should be kept at low temperatures such as 20℃ or lower. On the other hand, the difference in the

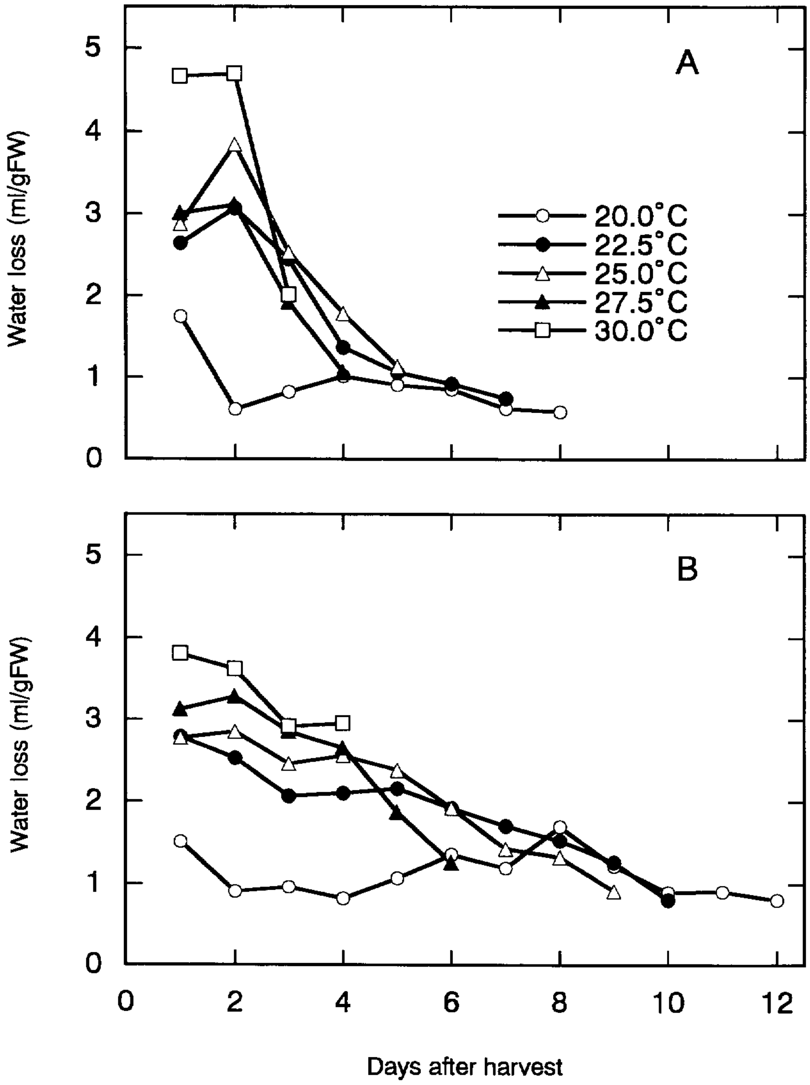

Fig. 7 Effects of temperatures and application of aluminum sulfate on water loss of cut rose flowers. Cut flowers were treated with distlled water (A) and aluminum sulfate solution (B). Values are means of duplicate experiments.

vase life between control flowers and those treated with aluminum sulfate was most pronounced at 25℃ (Fig. 3). Thus, a relatively long postharvest life can be expected at about 25℃ in the presence of a preservative.

Aluminum sulfate treatment slightly extended the vase life of cut rose flowers at 20℃ (De Stigter, 1981; Put et al., 1992). We also observed that the extension of the vase life by aluminum sulfate treatment was relatively negligible at 20℃, while the effect was relatively pronounced at 25℃ (Fig. 3). Aluminum sulfate is known to be an effective germicide (Put et al., 1992). Since bacteria proliferating in the vase water shorten the vase life of cut rose flowers, the beneficial effect of aluminum sulfate may be partially due to its germicidal activity. Furthermore, Al^{3+} ion has been shown to inhibit the transpiration of leaves in *Vicia faba* (Schnabl and Ziegler, 1975; Schnabl, 1976). In this study, it was also suggested that the transpiration was inhibited by aluminum sulfate (Fig. 7). Excess transpiration causes water deficit, which shortens the postharvest life of cut roses (Van Doorn, 1997). Therefore, in addition to its germicidal activity, the beneficial effect of aluminum sulfate treatment on postharvest life is probably due to the inhibition of transpiration.

Aluminum sulfate treatment markedly inhibited the occurrence of bent-neck (Fig. 4), which is caused by water deficit (Burdett, 1970; Zieslin et al., 1978). The amount of water loss from cut flowers treated with aluminum sulfate at 30℃ was greater than that of the flowers treated with water at 22.5℃ (Fig. 7). However, in control flowers kept at 22.5℃, bent-neck occurred more frequently than in those treated with aluminum sulfate at 30 ℃ (Fig. 4). Therefore, the inhibition of bent-neck by aluminum sulfate may not be due to the inhibition of transpiration. Since bacteria cause bent-neck in cut roses, this effect may be partially due to the germicidal activity of aluminum sulfate.

The vase life of cut roses was relatively short at 30℃ even when cut flowers were treated with an aluminum sulfate solution (Fig. 3). Since aluminum sulfate is an effective germicide, the short vase life at this temperature was not attributed to bacterial growth. On the other hand, the respiration rate increases when the temperature is higher (Pasian and Lieth, 1989; Jiao et al., 1991). Therefore, sugars consumed for respiration could be related to this phenomenon. This assumption is supported by the findings that the addition of sugars such as sucrose to vase water extended the vase life of cut roses (Marousky,1969; Gilman and Steponkus, 1972; Parups and Chan, 1973; Kaltaler and Steponkus, 1976).

Summary

Effects of temperatures, 20, 22.5, 25, 27.5 and 30℃ and continuous treatment with aluminum sulfate on the postharvest life of rose (*Rosa hybrida* L.) cv. Sonia were investigated. When the temperature was higher, flower opening was more accelerated. Continuous treatment with aluminum sulfate slightly accelerated flower opening. Regardless of aluminum sulfate treatment, the vase life was shorter when the temperature was higher.

Aluminum sulfate treatment extended the vase life at all the temperatures examined, particularly at 25℃. In the control flowers, bent-neck occurred more frequently when the temperature was higher. Aluminum sulfate treatment markedly inhibited the occurrence of bent-neck at all the temperatures examined. Regardless of treatments, fresh weights of cut flowers once increased and thereafter decreased. Fresh weight started to decrease earlier when the temperature was higher. Aluminum sulfate treatment extended the time of fresh weight decrease by about one day at all the temperatures except at 30℃. Water uptake of cut flowers decreased with time at all the temperatures except at 20℃ at which the rate of water uptake was constant throughout the experimental period. Changes in water loss were almost the same as those of water uptake.Aluminum sulfate treatment inhibited water loss and maintained water uptake.

These results indicate that the postharvest life of cut rose flowers is markedly affected by the temperature. It is also suggested that aluminum sulfate treatment is effective in extending the postharvest life by improving water relations.

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温度と硫酸アルミニウムがバラ切り花の品質保持に及ぼす影響

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摘　要

温度（20, 22.5, 25, 27.5 および 30℃）と硫酸アルミニウム（100mg ℓ^{-1}）の連続処理がバラ‘ソニア’切り花の品質保持に及ぼす影響を調べた．開花は温度が高いほど早くなり，硫酸アルミニウムはやや開花速度を早める効果を示した．花持ち日数は温度が高くなるほど短縮した．硫酸アルミニウムは調べたどの温度でも花持ち日数を延長させ，その効果は特に 25℃で高かった．また硫酸アルミニウムはベントネックの発生を著しく抑制した．処理の有無にかかわらず切り花の新鮮重は一度増加し，その後減少するパターンを示したが，減少に転じる時期は温度が高いほど早くなった．水の吸収量および損失量は温度が高いほど多くなったが，20℃の場合を除いて時間の経過とともに減少した．硫酸アルミニウム処理は処理後数日間の水の損失を抑制するとともに，長期間にわたり水の吸収を維持した．

以上の結果から，バラ切り花の花持ち日数は温度が高いほど短縮すること，硫酸アルミニウムの連続処理はバラ切り花の水分状態を良好にすることにより，特に 25℃前後の温度で花持ち延長に効果を示すことが明らかとなった．

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