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EFFECT OF DIFFERENT TYPES OF WATER ON THE POSTHARVEST KEEPING QUALITY OF CUT ROSE FLOWERS (*Rosa hybrida* L.) CV. "Eccentric".

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ABSTRACT

This study was conducted in the laboratory of the Veget. and Flor. Dept., Fac. of Agric., Mansoura Univ. during spring of 2002 and 2003 seasons on the cut rose flowers (*Rosa hybrida* L.) cv."Eccentric" obtained from a commercial rose farm at El-Kanater area. It aimed to study the effect of the drinking tap water of Mansoura City and four mineral drinking water types (Aqua, Baraka, Nestle, and Siwa) compared with the distilled water on postharvest keeping quality of cut rose flowers.

The results showed that keeping cut rose flowers in distilled water was best for longest vase life, highest water uptake and fresh weight gain of the flowers in addition to the best changes in weight throughout their vase life. Tap and Siwa water types ranked second, followed by Aqua and Nestle, while Baraka water was the least in all parameters.

Water analysis revealed that the main effect of water type on vase life and quality of cut roses was related mainly to the total dissolved solids in the water, since the results showed that the lower the total dissolved solids (TDS) in the water, the better was the keeping quality of cut roses and vice versa. It was concluded that the retarding effect of Baraka water on the keeping quality of cut roses might be due to the highest total dissolved solids (TDS), and the harmful effect of the highest sodium (Na^+) and bicarbonate (HCO_3^-) concentrations in this water type, compared with the other water types.

INTRODUCTION

The quality (composition) of tap water affects the keeping quality of the flower and/or the effectiveness of the chemicals used in the preservative solutions (Rogers, 1973; Neumaier *et al.*, 1999). The effect of water composition on cut flowers depends on the cut flower species, acidity of the water (pH), total dissolved solids (TDS), and the concentration and presence of certain ions (Waters, 1968; Marousky, 1974; Staby and Erwin, 1978; Durkin *et al.*, 2001). Since the composition of tap water varies greatly with the different sources and locations, there has been a universal trend of using distilled water for post-harvest handling of the cut flowers (Halevy and Mayak, 1981).

Recently, Meeteren *et al.*, (2000) questioned the appropriateness of deionized water as a control treatment in vase life experiments. Moreover, many researchers used tap water in their recent post-harvest researches on the cut flowers (De and Bhattacharjee, 1997; Holcomb *et al.*, 1998; Neumaier et al., 1999; Durkin *et al.* 2001; Izumi, 2001). In fact, distilled water is expensive, relatively not easy to obtain, and needs special preparations to produce large amounts of it. On the contrary, tap water cost much less and is easy to obtain at large amounts. Early report by Coorts and Gartner, (1969) showed that tap water was better for keeping quality of cut roses than deionized water. Furthermore, Holcomb *et al.*, (1998) reported that tap water was better for roses than 0.5% Floralife preservative solution, and Meeteren *et al.*, (2000), reported that deionized water showed sharper decrease in fresh weight and more hydraulic resistance in stems of cut chrysanthemum compared with tap water.

In Egypt, most retailers and consumers use tap water to keep their cut flowers and to prepare their preservative solutions. Nowadays, different types of mineral water are available in the local market at lower prices than distilled water. These types of water vary in their composition depending on their sources and were not examined for their effects on the keeping quality of cut flowers. As a consequence, it was necessary to evaluate different alternative sources of water available in Egypt on the keeping quality of cut flowers. This study was planned to compare among tap water of Mansoura City, four different types of mineral healthy water (Aqua, Baraka, Nestle, and Siwa), and distilled water with regard to their effects on vase life, quality, and water relations of cut roses.

MATERIALS AND METHODS

The experiment was performed during spring of the two successive seasons of 2002 and 2003 at the Department of Vegetable and Floriculture, Faculty of Agriculture, El-Mansoura University. The red cut flowers of Rosa hybrida cv. 'Eccentric' collected from a commercial rose farm at El-Kanater area were tested in this study. Flowers were cut early in the morning at the commercial stage of development (when the sepals started to reflex) and were immediately transported within two hours to the laboratory at Mansoura University.

Upon arrival, flowers of similar opening stage and head size with healthy green foliage were selected and then graded according to the length of the stem. The lowermost leaves were stripped from the stem leaving only the three uppermost five-leaflet leaves on each stem. The basal part of the stem was re-cut under water at 30 cm length from the base of the flower head. All stems were dipped in 2% Sodium hypochlorite (NaOCl) solution for few seconds and then rinsed with autoclaved distilled water before treatment. The fresh weight of each flower was recorded as the initial fresh weight and every three flowers were placed in one litre Erlenmeyer flask filled with the designated water type and left under the laboratory conditions at 23 °C and 60-70% relative humidity. Each treatment (water type) contained 5 flasks, each of them contained three flowers. Additional three flasks filled with similar water type without flowers were added to each treatment and placed in the laboratory under the same conditions, in order to measure the average daily evaporation value. Every 24 hrs, flowers were weighed in order to estimate the daily changes in the flower fresh weight. The percentage of maximum fresh weight gain was calculated based on the initial fresh weight.

Each flask without the flowers was weighed at the beginning of the experiment and every day thereafter to calculate the average water uptake by the flower. The daily water uptake (g/flower/day) was measured as the reduction in the flask weight divided by number of the flowers (after subtracting the average daily evaporation value). Flowers were observed daily, and vase-life of the flower was terminated when the flower showed bent neck, petal bluing or abscission, or when permanently wilted.

Water samples were chemically analyzed at the laboratory of the General Organization for Land Reclaimation Project, Ministry of Agriculture, El-Dokki, Giza.

Statistical analysis:

The experiment was repeated twice in each single season on the 1st and 10th of May. Each treatment (water type) included five flasks, and each flask containing three flowers was considered as a replicate. The experiment was analysed as completely randomised design with 5 replicates using SAS computer software program (SAS Institute, 1985). Treatment differences were determined by ANOVA, while means separation was by a test for least significant difference (LSD), (probability 5 %).

RESULTS AND DISCUSSION

Table (1) showed the vase life, daily water uptake, and the percentage of maximum weight gain of cut roses placed in different water types. The data showed that cut roses placed in the distilled water had significantly the longest vase life in both seasons (6.1 & 5.7days) among those placed in all water types. Cut roses placed in tap water ranked second and their vase life averaged 5.1 and 5.2 days in the first and second season respectively. Moreover, flowers placed in Baraka water had significantly the shortest vase life of 3.8 and 4 days only in both seasons respectively. Data showed also that flowers placed in Siwa mineral water did not significantly differ in their vase life with either tap water or the other two mineral waters (Aqua and Nestle).

The Table also showed that the highest daily water uptake was that of flowers placed in the distilled water, and averaged 24.3 and 23.7 (g/flower/day) in the first and second seasons respectively. The average daily water uptake of flowers placed in tap water was not significantly different from those in distilled water treatment. However, non significant differences existed among tap water, Aqua, Nestle, or Siwa, but flowers placed in Baraka water had significantly the least water uptake among all water types (20.3 and 20 g/flower/day in the first and second seasons, respectively).

The data of Table (1) also showed that flowers placed in the distilled water had the highest significant fresh weight gain of 16.1 and 14.3% of the original weight in the first and second seasons respectively. In contrast, the lowest fresh weight gain was that of flowers placed in Baraka water, which averaged 12.7 and 11.7% in the same respective order. However, the other four types of water (tap, Aqua, Nestle, and Siwa) did not significantly differ among each other in this parameter, but those placed in tap water had relatively higher weight gain than the other three types.

Table(1):Effect of different water types on vase life, daily water uptake and maximum fresh weight gain of cut roses during 2002 and 2003 seasons.

Water Type	Vase life (days)		Water uptake (g/flower/day)		Maximum fresh weight gain %	
	2002	2003	2002	2003	2002	2003
Distilled	6.1	5.7	24.3	23.7	16.1	14.3
Tap	5.1	5.2	23.9	22.9	14.3	12.8
Aqua	4.6	4.3	22.7	22.4	13.5	12.5
Baraka	3.8	4.0	20.3	20.0	12.7	11.7
Nestle	4.5	4.5	22.0	21.6	13.8	12.6
Siwa	4.7	4.8	22.9	22.2	14	12.5
LSD 5%	0.6	0.4	1.3	1.3	1.3	1.1

*Data represented in each season is a result of two consecutive experiments carried out on 1st and 10th of April.

The termination of vase-life of many cut flowers is characterized by wilting, even when they are constantly held in water. After flowers are cut and placed in water, they exhibit changes in fresh weight and those changes reflect the balance between water uptake and water loss (Halevy and Mayak, 1981).

Typically, cut flowers initially increase and subsequently decrease in fresh weight (Rogers, 1973). In this experiment, weight changes followed the same trend and the effect of different water types on changes in fresh weight (g / flower/day) of cut roses during vase-life is graphically demonstrated in Figure (1).

The graph clearly showed that all flowers exhibited maximum fresh weight gain after one day from placing them in all water types, with superiority of those placed in the distilled water. Flowers placed in tap and Siwa types ranked in the second place, followed by those placed in Aqua and Nestle, while those placed in Baraka were the least. On the second day, the trend was similar, but fresh weight gained by the flowers was less than that of the first day.

By the third day, differences started to be more obvious since flowers placed in either the distilled water or tap water gained weight, but those of the other four water types started to decrease in weight and continued thereafter. The sharpest decrease in fresh weight among those four types of water on this day was apparent in flowers placed in Baraka water. By the fourth day, flowers placed in both the distilled and tap waters started to decrease in weight and continued thereafter, but the decrease in weight was sharper in case of flowers placed in tap water compared with those placed in the distilled water.

The chemical analyses of the different water types are shown in Table (2). The pH values of the distilled and tap water of 6.8 and 7.1 respectively were less than those of the other four types which ranged between 7.6 and 8. Lowering the pH of the water or other holding solutions increased water uptake and vase life of the cut flowers (Halevy and Mayak, 1981).

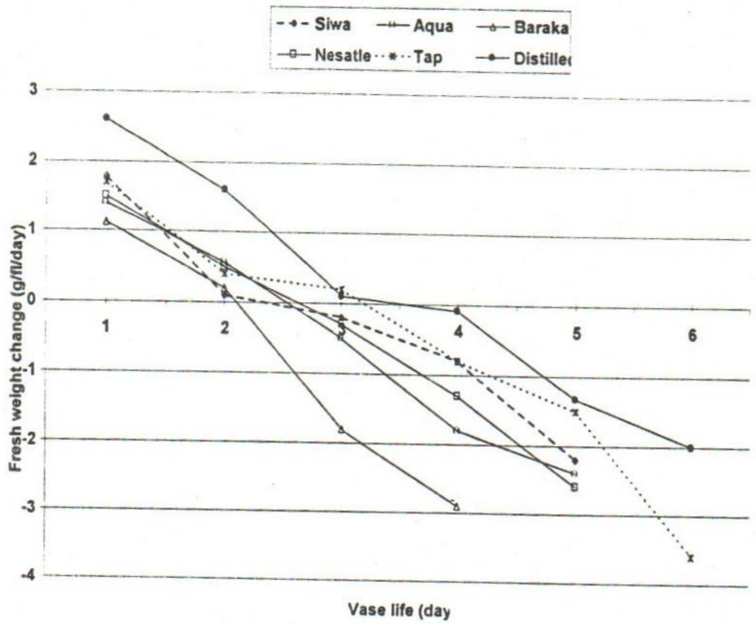

Figure (1). Effect of different water types on daily fresh weight changes (g/flower/day) during vase life of cut roses.

Previous work by other researchers, including the author, showed that pH values of 3.5 – 4 were needed in order to induce such effects (Marousky, 1971; Abdel-Kader and Rogers, 1986; Durkin, 1979; durkin et al., 2001). The pH values and differences in this experiment could not be accounted for the differences among different water types in their effects on water uptake and vase life of cut roses.

The total dissolved solids (TDS) was the lowest in the distilled water and was present in minute amount of 4 ppm, followed by those of tap and Siwa of 173 and 179 ppm respectively, while Nestle and Aqua contained 250 and 253 ppm respectively, and Baraka was the highest of 430 ppm. Previous research showed that TDS of water affected the vase life of the cut flowers (Rogers, 1973; Halevy and Mayak, 1981). The results herein are in accordance with this view since the longest vase life of cut roses was achieved using the distilled water which contained the lowest TDS, followed by tap water and Siwa, then Aqua and Nestle, while Baraka, which resulted the shortest vase life, had the highest TDS value. The lower the TDS of the water, the more the gradient differences in water potential between the cut flower and the water, allowing the flower to uptake more water and maintain favorable water balance over a longer period during their vase life. Thus, it would increase vase life and weight gained by the flower which coincided with the results shown in Table (1) and Fig. (1). In this concern, Waters, (1968) indicated that longevity of cut roses was reduced by TDS of 200 ppm, while Staby and Erwin, (1978) found no relation between TDS and vase life of cut chrysanthmums. Similar results were those of the electrical conductivity (EC) values of the same Table.

It was also obvious from Table (2) that the distilled water contained traces of both cations and anions, but varying concentrations were found in other water types. It was clear that Baraka water had the highest concentrations of both cations and anions. The highest sodium concentration (Na) of 2.04 (meq/L) and HCO_3 (5 meq/L) in Braraka water seems to contribute to the retarding effect of Baraka water on vase life of cut roses, since previous results showed that Na had a retarding effect on vase life of cut roses (Halevy and Mayak, 1981) and that NaCO3 was more toxic to roses than NaCl (Lancaster, 1975). It was also clear that tap water contained less concentration of 0.12 (meq/L) of this ion compared with other water types which might explain why tap water ranked second in the vase life and water uptake of its flowers after distilled water. Tap water was also relatively better than Siwa water, which contained 1.83 (meq/L) of sodium ion. However, these two water types did not significantly differ in the vase life of their cut flowers, probably because tap water contained more HCO_3 than Siwa water. In addition, Siwa water contained the highest concentration of K, which might have a positive effect on vase life of the cut flowers, since potassium ion and its associated anions were the main natural osmotic constituents in carnation flowers (Acock and Nichols, 1979).

Table 2. Chemical composition of different water types.

Water type	pH	TDS	EC*	Cations (meq/L)				Anions (meq/L)			
				Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
Distilled	6.8	4	0.001	Trace	Trace	Trace	Trace	0	Trace	Trace	Trace
Tap	7.1	173	0.27	2.2	0.34	0.12	0.04	0	1.64	0.02	0.86
Aqua	7.6	253	0.4	1.53	1.08	1.65	0.09	0	3.2	0.68	0.16
Baraka	8.0	430	0.67	3.2	2.0	2.04	0.13	0	5.0	0.96	0.5
Nestle	7.8	250	0.39	2.52	0.6	0.57	0.04	0	0.13	1.89	0.13
Siwa	7.6	197	0.31	0.24	0.51	1.83	0.36	0	1.8	0.29	0.14

*** E.C. (millimohs/cm) × 640 = T.D.S. (ppm).**

Since Aqua and Nestle types contained medium amount of most ions, they had intermediate response among different water types. However, certain concentrations of cations or anions in water might interact among each other and the effect of their interactions on vase life and keeping quality of cut flowers is a very complicated process.

CONCLUSION

The total dissolved solids of the water seemed to be the main factor that affect the keeping quality of cut roses by affecting water uptake through its effect on the gradient differences in water potential between the flower and a specific water type. In addition, the presence of certain ions at specific concentrations might be harmful (like Na+ and HCO_3^-) or useful (like K^+) to the vase life of the cut flower. These two factors determine to a certain degree the possibility of using any type of water for keeping the cut flowers.

The results of this work are very useful and promising as well, since the vase life cut roses held in tap water ranked second after those held in the distilled water and was shorter by an average 0.75 day only in the two seasons.

Considering the fact that roses and carnation were sensitive flowers to 200 ppm TDS while chrysanthemums were not, it might be possible that other flowers could keep well in tap water similar to the distilled one. As a consequence, this study could be the basis for further ones including; testing tap water on other cut flowers species and cultivars, the use of a mixture of tap and distilled water, and the use of different pulsing solutions prior to keeping (holding) the flowers in tap water.

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تأثير أنواع مختلفة من الماء على جودة ما بعد الحصاد لزهور الورد المقطوفة (*Rosa hybrida* L.) CV. "Eccentric"

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تم إجراء هذه الدراسة فى معمل قسم الخضر و الزينة بكلية الزراعة جامعة المنصورة خلال الربيع فى عامى ٢٠٠٢ و ٢٠٠٣ على الزهور الورد المقطوفة (*Rosa hybrida* L.) صنف "Eccentric" و التى تم الحصول عليها من مزرعة ورد تجارية بمنطقة القناطر. و كان الهدف دراسة تأثير ماء الصنبور بمدينة المنصورة و أربعة أنواع من مياه الشرب المعدنية (أكوا و بركة و نستلة و سيوة) بالمقارنة مع الماء المقطر على جودة الحفظ لزهور الورد بعد القطف.

و لقد أظهرت النتائج أن حفظ زهور الورد المقطوفة فى الماء المقطر كان الأفضل و ذلك بالنسبة لأطول عمر بالفازة و أكبر إمتصاص للماء و أكثر زيادة فى وزن الزهور بالإضافة إلى أفضل تغيرات فى وزن الزهور خلال عمر الزهرة فى الفازة. وكان ماء الصنبور وماء سيوة فى الترتيب الثانى يليهما ماء أكوا ونستلة فى حين أن ماء بركة كان الأقل فى جميع القياسات.

ولقد أظهر تحليل المياه أن تأثير نوع الماء على عمر وجودة زهور الورد يرجع أساسا إلى نسبة المواد الصلبة الذائبة به حيث أظهرت النتائج أنه كلما إنخفضت نسبة المواد الصلبة الذائبة فى الماء كلما زادت جودة الحفظ لزهور الورد و العكس صحيح. ولقد تم إستخلاص أن التأثير المثبط لماء "بركة" على قدرة حفظ زهور الورد بعد القطف يرجع لأنه الأعلى فى نسبة المواد الصلبة الذائبة بالإضافة للتأثير الضار لأعلى نسب من أيونات الصوديوم و البيكربونات و الموجودة بهذا النوع من الماء بالمقارنة بأنواع المياه الأخرى.