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Effects of Bactericides and Sucrose-Pulsing on Vase Life of Rose Cut Flowers (*Rosa hybirida*)

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Abstract: The vase life of rose cut flowers were studied to determine the physiological factors that affect the rate of senescence.Cut rose flowers were obtained from a commercial grower in Taif, Sudia Arabia and treated with 8-hydroxyquniline sulfate (8-HQS) at concentrations of 100, 200 or 300 ppm and sucrose at 1, 2, or 3% w/v. Longevity of cut roses was determined on the basis of wilting, chlorophyll retention and carbohydrate degradation. After treatment the cut roses were kept at room temperature (23± 1 °C) under normal day light and natural ventilation. The vase life of cut flowers studied were prolonged by all 8-HQS treatments. The best concentration was 100 ppm. The effect was further improved when 8-HQS was combined with 3% sucrose, which recorded the best vase life compared to other concentrations of sucrose. The per cent of wilting was minimized as a result of using this combined treatment. However the per cent of wilting increased with the increase in concentrations of 8-HQS and complete wilting occurred after 10, 8 and 7 days when treated with 100, 200 and 300 ppm of 8-HQS, respectively, while sucrose shortened the period to reach wilting. Also 8-HQS at 100 ppm retarded the chlorophyll as well as carbohydrate degradation during the postharvest life. These experiments were carried out in the laboratory of the Department of Biology, Taif University, Saudi Arabia. The experiments were repeated three times with three replicates and a completely randomized design had been used. The experiments extended from February, 2006 to September, 2008. The difference between means were performed using Duncan multiple range test at 0.05 level.

Key words: Vase life · 8-HQS · Rose plant · Sucrose pulsing

INTRODUCTION

Roses (*Rosa hybirida*) belong to family Rosaceae are recognized for their high economic value, which are used in agro-based industry especially in cosmetics and perfumes. Additionally, roses play a vital role in the manufacturing of various products of medicinal and nutritional importance. However, the main idea of rose plant cultivation is to get the cut flowers, which greatly deals with the floricultural business [1].

Vase life of cut rose flowers is usually short. Cut flowers wilt and floral axis become bent (bent-neck) just below the flower head [2].The development of such symptoms is considered to be caused by vascular occlusion, which inhibits water supply to the flowers [3].

Several methods to increase the vase life of cut flowers and keep their freshness for longer periods have been reported. Cut flowers should be free of any deterioration, as this is one of the principal entry points for decay organisms [4]. A major form of deterioration in cut flowers is the blockage of xylem vessels by air and microorganisms that cause xylem occlusion[4].

The germicide 8-hydroxyquinoline sulfate (8-HQS) is one of the very important preservatives used in floral industry [5]. Also, sucrose acts as a preservatives materials, in addition to extending the vase life of cut flowers. Different concentrations of sucrose had been investigated by Butt [6] on two cultivars of *Rasa hybirida* and results showed that sucrose at 25 gml^{-1} extended the vase life by 8.2 days in var. Whisk Mc and 7.5 days in var. Trika as compared to 5.3days in control [6]. Also Pun *et al.* [7] treated cut spry carnation by different concentrations of sucrose ranging from 0 to 7.5% and found that 5.0% sucrose recorded the best vase life and delayed the climacteric ethylene in petals.

Furthermore, sugars with biocides have become an important commercial preservative for several cut flowers [8]. Application of HQS significantly increased the vase life as well as the gain of fresh weight of rose cut flowers. The treatments were more effective when sucrose was added to HQS [9].

Flower diameter of cut roses, total water uptake and vase life for rose cut flowers had increased when using 8-HQS + sucrose in comparison to control [10]. Also,

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preservative solutions containing 3% sucrose and 200 ppm 8-HQS extended the vase life and inhibited flower senescence and bent neck in rose cut flowers [11]. 8-HQS treatment prevented the growth of microorganism in xylem and thus maintained water uptake by Freesia flower stems. Beura *et al.* [12] showed that the combination treatment of 8-HQS and sucrose improved the postharvest quality of Gladiolus spikes. In Dendrobium flowers, holding solutions containing 8-HQS + sucrose extended the vase life and improved flower quality, water consumption, fresh weight and flower freshness [13]. The combined solution treatment also reduced respiration rate and physiological loss in weight [13].

MATERIAL AND METHODS

Plant Materials: Cut flowers of roses were obtained from a commercial grower in Taif, Saudi Arabia. Flower stems were trimmed to 30 cm underwater to avoid air embolisms [14]. All leaves on the lower section of the stem were removed.

Experiment (1): 8-hydroxyquinoline sulfate (8-HQS) was applied at concentrations of 0, 100, 200 or 300 ppm.Sucrose was used at concentrations of 0, 1, 2 or 3% w/v [15]. The two compounds were dissolved in sterilized distilled water in 250ml bottle glass [16]. The sample had been divided into seven groups with three replications containing three flowers each. The flowers were kept at room temperature (23± 1°C) at normal day light and natural ventilation. Visual rating of flowers was carried out on the basis of a scale from 1 to 4 according to Hassan [17] where: 1=entirely fresh flowers and 4= wilting in 50-100% of the petals.

Experiment (2): 8-HQS at concentration of 100 ppm and sucrose at concentration 3% (w/v) gave the best results in experiment (1). Hence, the effect of both concentrations of 8-HQS and sucrose on chlorophyll retention and carbohydrate degradation were further investigated.

Chlorophyll Determination: Chlorophyll was extracted by methanol and absorbance was determined by a spectrophotometer on day 1, 3 and 5, when the vase life of control was terminated, according to the method of Harborne [18]. Chl *a* and Chl *b* were then calculated using the flowing equation:

$$\text{Chl } a \text{ (mg1}^{-1}) = 12.21\ A_{663} - 2.81\ A_{646}.$$
$$\text{Chl } b \text{ (mg1}^{-1}) = 20.13 A_{646} - 5.03 A_{663.}$$

Carbohydrates Determination: Carbohydrates were determined on the stems and petals of the best treatment of the two compounds. Samples were taken on day 1, 3 and 5 and separated by a high performance liquid chromatography (HPLC) fitted with differential refractometer to detect fructose, glucose and sucrose in the different sample [17].

RESULTS

Effect of 8-HQS and Sucrose on Vase Life of Rose Cut Flowers: The vase life of rose cut flowers was extended by the different concentrations of 8-HQS used (Table 1). The vase life was longer in 8-HQS at 100 ppm which resulted in 8.97 days compared to other concentrations (Table 1). Sucrose resulted in the lowest vase life compared to 8-HQS at the different concentrations used. The longest vase life was attained when sucrose was applied at 3% w/v, which gave 6 days in comparison to 5 days for control. However, the two compounds used significantly extended the vase life of rose cut flowers compared to control.

Table 2 showed that the per cent wilting increased with the increase in concentrations of 8-HQS. The vase life was terminated on day 11, 10 and 9, when cut flowers were treated with 100, 200 and 300 ppm 8-HQS, respectively compared to 6 days in control. Sucrose resulted in the lowest period to reach wilting per cent. Thus, wilting occurred on the 8th day after treatment with sucrose at different concentrations compared to 6 days in control (Table 2).

Effect of the Best Treatment for 8-HQS and Sucrose on Vase Life and Postharvest Quality of Rose Cut Flowers: Results of Table 3 showed that treatment by 8-HQS at 100 ppm prolonged the vase life of rose cut flowers with or without sucrose compared to control. When sucrose was added to 100 ppm 8-HQS, the vase life was extended

Table 1: Effect of 8-HQS and sucrose on vase life of rose cut flowers (*Rosa hybirida)*

Treatment	Vase life(days)[1]
8-HQS 100ppm	8.97 a
8-HQS 200ppm	7.64 b
8-HQS300ppm	7 c
Sucrose 1%	5.77 e
Sucrose 2%	5.97 de
Sucrose 3%	7.07 bc
Control	4 f

[1]Different letters indicate the significant differences between means, according to Duncan multiple range p= 0

Table 2: Calculation of per cent wilting in rose cut flowers treated with different concentrations of 8-HQS and sucrose compared to control

	Per cent of wilting in the different concentrations of 8-HQS and sucrose[1]						
	8-HQS conc. (ppm)			Sucrose conc. % (w/v)			Control
Days after treatments	100	200	300	1	2	3	0
2	2.6	3.7	5.3	3.9	3.6	2.4	3.6
4	16.5	18.8	26.7	26.2	25.3	22.6	54.9
6	46.6	57.9	63.9	74.3	56.6	61.9	98.5
8	78.6	93	93.6	93.3	94.8	92.3	-
10	95.3	97	96	-	-	-	-
11	98.5	-	-	-	-	-	-

[1] reading of per cent wilting was done every tow days after treatments.

Table 3: Effect of the best treatment of 8-HQS and sucrose on vase life and postharvest quality of rose cut flowers

Treatments	Vase life values(day)
8-HQS 100ppm	9 b
8-HQS 100ppm+ sucrose 3%	12 a
Sucrose 3%	7 c
Control treatment	5 d

Letters explain the significant differences between means, according to Duncan multiple range p= 0.05.

Table 4: Effect of 8-HQS with or without sucrose and sucrose alone on chlorophyll content for rose cut flowers

	Days of determination of chl. *a*[1] and chl. *b*[1]					
	1st day		3rd day		5th day	
Treatments	Chl. *a*	Chl. *b*	Chl. *a*	Chl. *b*	Chl. *a*	Chl. *b*
8-HQS 100ppm	0.672	0.330	1.767	0.599	1.892	0.404
8-HQS 100ppm+sucrose3%	0.734	0.410	1.941	1.163	1.762	0.391
Sucrose 3%	0.733	0.410	1.421	0.743	0.687	0.186
Control treatment	0.727	0.384	0.940	0.406	0.596	0.070

[1]mg 1^{-1} fresh weight.

Table 5: Effect of 8-HQS with or without sucrose and sucrose alone on carbohydrate content (in mg^{-1} dry weight) for petals of rose cut flowers

	Days of determination of carbohydrate content								
	1st day			3rd day			5th day		
Treatment	Fructose	Glucose	Sucrose	Fructose	Glucose	Sucrose	Fructose	Glucose	Sucrose
8-HQS 100 ppm	2.87	1.97	1.00	2.06	2.99	0.08	1.96	1.26	0.17
8-HQS 100ppm+sucrose 3%	4.18	3.55	1.23	5.97	4.34	1.99	2.87	1.63	1.01
Sucrose 3%	1.35	1.97	0.93	2.99	1.95	1.22	0.37	0.88	0.11
Control	0.91	0.30	0.08	0.13	0.03	0.02	0.65	0.18	0.26

Table 6: Effect of 8-HQS with or without sucrose and sucrose alone on carbohydrate content (in mg^{-1} dry weight) for stems of rose cut flowers

	Days of determination of carbohydrate content								
	1st day			3rd day			5th day		
Treatment	Fructose	Glucose	Sucrose	Fructose	Glucose	Sucrose	Fructose	Glucose	Sucrose
8-HQS 100 ppm	1.95	1.00	0.16	2.43	2.00	1.45	0.87	1.08	0.69
8-HQS 100ppm+sucrose 3%	2.21	1.30	1.07	3.53	2.11	1.97	1.51	0.40	0.84
Sucrose 3%	1.17	1.08	0.32	2.32	2.00	1.23	0.89	0.47	0.09
Control	0.91	0.30	0.08	0.70	0.60	0.11	0.62	0.43	0.19

to 12 days compared to 9 days without sucrose. However, sucrose at 3% extended the vase life by 7 days compared to 6 days only in control (Table 3).

Chlorophyll Content: The previous treatments lead to a considerable delay in degradation of Chl *a* and Chl *b* compared to control (Table 4). The concentration of chlorophyll *a* was higher than chlorophyll *b* at any point of time throughout the vase life. When flowers were treated with 8-HQS 100 ppm chlorophyll content on the 1st day was 0.672, 0.330 mg 1^{-1} weight for chl. *a* and chl. *b*, respectively (Table 4).When sucrose at 3% was added chlorophyll content increased. Thus, at the end of the experiment the accumulated chl. *a* and chl. *b*, were 1.762, 0.391 mg 1^{-1}, respectively (Table 4).

Carbohydrate Content: Data of Tables 5 and 6 show that fructose, glucose and sucrose were the main soluble carbohydrates in petals and stems of cut roses. Fructose was the major component in the petals as well as in stems but, generally, its value was higher than in stems. Sucrose contents in petals and stems were lower than those of glucose.

The carbohydrate content significantly increased as a result of using 100ppm 8-HQS + 3% sucrose till the 3rd day then sharply decreased on the 5 thday at which the vase life of control was terminated. The concentrations of fructose, glucose and sucrose in rose petals were 0.65, 0.18 and 0.26 mg g^{-1} dry weight in controls at the end of the experiments (Table 5). At the same time values of these sugars in mg g^{-1} dry weight when petals were treated with 100 ppm 8-HQS and 100 ppm+ sucrose 3% and sucrose 3% alone were 1.96, 1.26 and 0.17, respectively(table 5).

While stem contents of the previous sugars increased at the beginning of the experiment, then decreased towards the end of the experiment compared to control (Table 6).

DISCUSSION

One of the greatest problems in postharvest flower physiology is the blockage of vascular system, due to air or bacterial growth[4],which reduces water uptake and this blocks xylem vessels leading to water stress[4]. That was expressed in the form of early wilting of leaves or flowers [19], as a result of premature loss of cell turgidity and might appear when water uptake and transpiration are out of balance during a lasting period of time.This finally leads to an unrecoverable situation and the premature end of flower vase life [20].

8-HQS is known to extend the vase life of rose cut flowers, by preventing the accumulation of microorganisms in xylem vessels [21].This explains the short vase life of untreated control and long vase life when 8-HQS was applied (Table 1).This in agreement with the observation of Kwon and Kim [21]where treatment of Freesia flower stem with 8-HQS prevented the growth of microorganism. Thus, 8-HQS may act as an antimicrobial agent and hence, reduce stem plugging.

Also, 8-HQS delayed wilting compared to control (Table 2),which is similar to findings by Kim and Lee[11]. Further, 8-HQS minimized losses in chlorophyll (Table 4) as well as carbohydrates (Tables 5, 6). This in agreement with earlier reports of (Hussein[22]; Knee[23]; Bhattacharjee[24] and Ichimura and Goto[9].

It is well known that sugar supply, increases the longevity of many cut flowers, since they act as a source of nutrition for tissues approaching carbohydrate starvation. It my also act as osmotically active molecule, thereby leading to the promotion of subsequent water relations [25]. Dissolved sugars in cells of petals are osmotically active substances that are drawn into the corolla-cells making the cells turgid with hydrolyzed sugars ready for respiration [25]. Similar findings were obtained by Ichimura [26]. When sucrose was added to 8-HQS the vase life of rose cut flowers was extended [10,12 and 13]. Preservative solutions containing sucrose + 8-HQS extended the vase life by inhibiting senescence and bent neck of rose cut flowers[11], which lead to improving the postharvest quality of the flowers.

Also, sucrose + 8-HQS reduced chlorophyll degradation and preserved carbohydrates content (Tables 5, 6). This might be inhibiting ethylene action and as a result, the vase life could be increased. [27, 28] reported that, the vase life of chrysanthemum cut flowers was significantly increased when treated with 8-HQS +sucrose. This was attributed to the inhibition of ethylene action by 8-HQS [27, 28].

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