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Prolonging of the Vase Life of Gerbera Jamesonii Treatment with Sucrose Before and, During Simulated Transport.

M. I. Yagi[a*], M. N. A. Elgemaby[b], Maha I. A. Ismael[c], Mohammed Almubarak A. A[d]

[a,c,d]Sudan University of Science and Technology, College of Agricultural Studies, Department of horticulture,.khartoum,Po.Box71.Khartoum North-Sudan

[b]Al-Taif University, Kingdom Saudi Arabia

[a]mahmoudyagi15@gmail.com

[b]nourde1@yahoo.com

Abstract

We provided this study to investigate the effects of treatment with sucrose plus MI/MI (an isothiazolinonic germicide) in combination with aluminum sulfate (CMI/MI-AS) and abscisic acid (ABA) before and. during simulated transport on the vase life of Gerbera' cut flowers. First, cut flower Gerbera wore held in solution containing 1% to 3% sucrose plus CMI/MI-AS at 10°C for 72 h. Thu flowers were then transferred to distilled, water (DW) and held at 23°C. Sucrose at 2% and 3% plus CMI/MI-AS significantly extended the vase life, although the effect was small. Next, flowers were held in solution containing 2% or 4% sucrose plus CMI/MI'AS, with or without ABA, at 10°C for 24 h to simulate storage, then at 15°C for 48 h to simulate transport, They were then transferred to OW and held at 23°C. The vase life was extended to as much as 4.5 times compare with treatment with DW. ABA did not significantly extend vase life; hut did increase fresh weight (FW). Sucrose uptake was greater at 15°C than at 10°C when the sucrose concentration was 2%. The difference in the extension of vase life between tile two experiments is apparently due to the amount of sucrose taken up.

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* Corresponding author.

E-mail address: mahmoudyagi15@gmail.com.

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1. Introduction

Gerbera jamesonii popularly known as Transvaal daisy is one of the ten most popular commercial cut flower in the world and according to the global trends in floriculture. It occupies the fourth place among cut flowers.

The vase life of cut Gerbera is generally short. Treatment with sucrose markedly prolonged the vase life of Gerbera, suggesting that the short vase life is due to a shortage of soluble carbohydrates [1]. It has also been attributed to vascular occlusion, which restricts the water supply to the flowers [2]. Treatment with antimicrobial compounds inhibits bacterial proliferation and suppresses the decrease in hydraulic conductance of cut G.jamesonii. These findings support the view that vascular occlusion is due mainly to bacterial proliferation [3, 4].

Keeping quality is an important parameter for evaluation for cut flower quality for both domestic and export markets. Addition of preservatives to the holding solution is recommended to prolong the vase- life of cut flowers. All holding solutions essentially must contain two components viz., sugar and germicides. The sugars provide a respiratory substrate, while the germicides control harmful bacteria and prevent plugging of the conducting tissues. Therefore the techniques of prolonging the vase- life of flowers will be a great asset to the growers and users.

Preservatives for consumers are the most effective of the three types in extending the vase life of cut roses [5]. Indeed, continuous treatment with sucrose plus an 8-hydroxyquinoline compound, such as 8-hydroxyquinoline sulphate (HQS) or 8-bydroxyquinoline citrate, extends the vase life of Gerbera cut flowers [6,7,8].

Furthermore, continuous treatment with .7 a formulation known as GLCA, which is composed of glucose, CMIJMI (a mixture of isothiazolinonic germicides), citric acid, and aluminum sulphate (AS), markedly extended the vase life of cut roses [9]. Since applied sugars are rapidly consumed in cut flowers, their slight effectiveness can be attributed to insufficient uptake. The uptake of sugars by cut flowers can be increased by treatment at high concentrations. However, sucrose or glucose at high concentrations damages the leaves of cut roses [10]. Since water uptake by cut flowers is suppressed in the dark [11] , the use of sugar solution in the dark ma thus avoid leaf damage.

Treatment with ABA significantly extends the vase life of cut flowers with leaves, but shortens it without leaves [12,13]. Hence, the effect of ABA is due to suppression of transpiration. ABA also suppresses damage to leaves caused by sucrose [10,14]. This effect is attributable to suppression of uptake of sucrose by inhibition of transpiration.

Here, we investigated the effect of treatment with sucrose plus CMI/MI-plus AS with or without ABA before and during simulated transport on the vase life of Gerbera jamesonii cut flowers.

2. Materials and Methods

Gerbera flowers were harvested when all florets opened fully and were perpendicular to the stalk. The flowers harvested early in the morning and were immediately placed in water for pre-cooling. These flowers had not undergone any preservation treatment before we obtained them, after harvesting, the cut ends of the stems were immersed in tap water, and the flowers were stored at 5°C overnight. Next day, the flowers whose cut ends were placed in tap water were transported to the laboratory and used within 2 h for the experiments.

2.1 Chemicals

Isothiazolinones are antimicrobials used to control bacteria, fungi, and algae in cooling water system .The antimicrobial CMI/MI-AS solution contained 283 ing L^{-1} 5-chloro-2'-methyl-4-isothiazoliw3-one, 98 mg L^{-1} 2-methyl-4isothiazolin-3-one, and 5 g L^{-1} aluminum sulphate as active ingredients.

Treatment with sucrose plus CMI/MI-AS under conditions simulating transport conditions (Exp. 1)

Two cut flowers 50 cm long were placed in each of four 500-mi beakers containing 125 ml of test solution (eight flowers per treatment) or distilled water (DW). Each solution contained 0, 10, 15, 20 or 30 g U1 sucrose and 20 ml U' CMIJMI-AS, The flowers were held at 10°C under 70% relative humidity in the dark for 72 h. They were then re-cut to 45 cm, and all but the upper three leaves were removed. The flowers were then placed in 500 mL DW, two to a beaker, and held at 23°C under 12-h photoperiod with 10 π mol m° &' irradiance from cool-white fluorescent lamps.

Treatment with sucrose plus CMI/M1-AS and ABA under conditions simulating storage and transport conditions (Exp. 2) Individual cut flowers 50 cm long were placed in test tubes containing 50 ml of test solution (eight flowers per treatment). The flowers were held in solutions of 0, 20, or 40 g L' sucrose, 20 ml L^{-1} CMI/MI-AS, and 0 or 1.0 µM ABA at 10°C and 70% to 75% RH in the dark for 24 h to simulate brief storage before transporting then at 15°C and 70% RH in the dark for 48 h to simulate wet transport. To simulate dry transport, eight flowers that had been held in DW for 24 h were placed in a corrugated cardboard box (29 cm X 73 cm X 11 cm) together with another 42 cut flowers 50 cm long. After simulated storage for 24 h followed by simulated transport for 48 h, the flowers were cut to 48 cm. They were then placed in 500 mL DW, two to a beaker, and held at 23°C, and 70% RH, under a 12-h photoperiod at 10 µmol m' s' irradiance from cool-white fluorescent lamps.

2.2 Evaluation of vase life

The FW and water uptake of cut flowers were measured daily. Relative FW was expressed as a percentage of initial FW. After cutting at the end of simulated transport, relative FW was corrected using the following equation:

Relative FW (%) (FW on each day/initial FW) <FW before cutting/FW after cutting)

Maximum flower diameter was recorded. The vase life was defined as the period from the end of chemical treatments to the time when the petals wilted or showed severe bluing. Determination of sucrose uptake by cut flowers.

In both Exp. I and Exp. 2, the volume of sucrose solution taken up by cut flowers from 24 h to 48 h after the start of treatment was determined as the difference in solution volume, and then corrected by subtracting the evaporation of water from a test tube without cut flowers. The amount of sucrose uptake was calculated from the volume taken up and the sucrose concentration. Sucrose uptake is proportional to solution uptake [6].

3. Results

Effect of sucrose plus CMI/MI-AS during simulated transport on vase life (Exp.1) The FW of cut flowers in all treatments increased during simulated transport. Subsequently, in DW and CMI/MI-AS, it increased slightly on the first day of vase storage, and then decreased sharply thereafter, in contrast, treatment with 1% to 3% sucrose plus CMI/M1 AS increased FW and maintained it at a relatively high level for up to 5 days. But those in sucrose plus CMI/MIAS opened almost completely.

Treatment with OMI/MI-AS extended the vase life slightly compared with treatment with DW Treatment with 2% and 3% sucrose plus CMI/MI-AS significantly extended the vase life (Table1). Uptake of sucrose increased with sucrose concentration (Table 2).

Table 1. Effects of various chemical treatments on the vase life of G.jamesonii cut Flower.

Treatment	Vase life [z] (days)
DW	2.8 ± 0.3a
CMI1MIAS	4.1 ± 0.iab
1% Sucrose + CMIIMIAS	4.8 ± 0.3ab
15% Sucrose + CMI/MI-AS	5.0. ± 0.5ab
2% Sucrose + CMIJMI-AS	5.2 ± 0.4ab
3% Sucrose + CMI/MFAS	6.2 ± 0.2b

Cut.G.jamesonii were treated in various solutions at 10°C for 72 h and then held in OW at 23°C.

ZJ5055 represent means of 4 replications ± SE. Values followed by the same letter do not differ significantly

(P<005, Tukey-Kramer multiple range test).

Table 2. Sucrose uptake by cut G.jamesonii

Treatment	Sucrose uptake %	
	(mg flower $^{-1}$ day^{-1})	(mg g $^{-1}$ FW day -1)
Sucrose + CMI/MJ-AS	326 ± 4.9	0.65 ± 0.05
1.5% Sucrose + CMIIMI-AS	359 ± 2.3	0.65 ± 0.01
2% Sucrose + CMI/MJ-AS	558 ± 5.8	2.21 ± 0.23
3% Sucrose + CMIIMI-AS	87.0 ± 6.7	144 ± 0.13

Gerbera jamesonii were treated in various solutions at 10°C for 72 h, and then the amount of sucrose taken up from 24 to 48 h after the start of treatment was determined. °Values represent means of 4 replications ± SE.

Effect of sucrose plus CMI/MJ-AS and ABA during simulated storage and transport on vase life (Exp. 2)

The FW of cut flowers in all treatments except dry transport somewhat increased during simulated storage and transport. That of dry-transported flowers increased during the first day in the vase, and then decreased there after that of flowers treated with DW did not increase in the vase.

Treatment with 2% and 4% sucrose plus CMIIMI-AS increased the maximum fresh weight more than treatment with CM1/MI-AS alone. This increase was enhanced slightly by ABA. Treatment with sucrose plus CMI/MI-AS maintained a higher DW for longer than treatment with CMI/MI-AS alone.

Vase life was shortest in dry-transported and DW-treated flowers. Treatment with CMI/MI-AS extended vase life slightly and that with 2% or 4% sucrose plus CMI/MI-AS extended it significantly. This extension of vase life was slightly enhanced by ABA in 2% sucrose. Flower diameter was significantly increased by treatment with 4% sucrose plus CMI/MI-AS, with or without ABA, and by treatment with 2% sucrose plus CMI/MI-AS with ABA, compared with that in DW (Table 3).

Flowers in the DW + dry- treatment were severely wilted and bent (A). Those in the DW treatment were wilted and blued (B). Similarly, flowers in the CMI1MI-AS treatment showed some bluing and wilting (C). In contrast, flowers in 2% and 4% sucrose plus CMI/MI-AS did not show bluing (D-F).

Sucrose uptake was higher in solution containing 4% sucrose than in solution containing 2% sucrose. ABA tended to decrease sucrose uptake (Table 4).

Table 3. Effect of various chemical treatments under conditions simulating storage and transport on the vase life of G.Jamesonii cut Flower.

Treatment	Vase life [z] (days)	Flower diameter [z] (mm)
I)W-Dry	2.5 ± 0.5a	89.5 ± 11.6a
DW	2.3 ± 0.3a	843 ± 5.9a
CMI/Ml-AS	4.2 ± 0.2a	98.8 ± 36abe
2% Sucrose + CMI/MI-AS	6.9 ± 0.7b	100.8 ± 4.Oabc
2% Sucrose + CMI/MI-AS ÷ABA	7.9 ± 0.5bc	113.1 ± l.9c
4% Sucrose + CMIIMIAS	9.9 ± 0.2c	112.5 ± 0.6bc
4% Sucrose + CMI/MI-AS + ABA	8.9 ± 0.4c	2.23.4 5: 3,6c

Treatment	Sucrose uptake z (mg flower $^{-1}$ day^{-1})	(mg g $^{-1}$ FW day -1)
2% Sucrose + CMIJMI-AS	126.3 ± 14.5	8.85 ± 0.96
2% Sucrose + CMI/MI-AS ÷ABA	114.5 ± 85	4.99 ± 0.54
4% Sucrose + CMIIMJ-AS	193.0 ± 13.2	8.89 ± 036
4% Sucrose + CMI/MI-AS ±ABA	178.0 ± 9.1	7.98 ± 0.38

G.jamesonii were treated in various solutions at 10°C for 24 h and at 15°C for 48 h and then held in DW at 23°C.

[z] Values represent means of 4 replications ± SE. Values within a column followed by the same letter do not differ significantly (P<O.05, Turkey-Kramer multiple range test).

Table 4. Sucrose uptake by cut G.jamesonii

G.jamesonii were treated in various solutions at 10°C for 24 h and at 15°C for 48 h, then the amount of sucrose taken up from 24 to 48 h after the start of treatment was determined.

[v]alues represent means of 8 replications ± SE.

4. Discussion

The vase life of G.jamesonii and Gypsophila flowers was shorter in dry transport than in wet transport [10]. Yet there was no significant difference in the present study (Table 3), although dry transport suppressed the increase in FW. As the increase in FW is due to petal growth [8] these findings suggest that water stress caused by dry transport suppresses petal growth.

In wet transport, antimicrobial compounds are used to inhibit bacterial proliferation [5], which shortens the postharvest life of cut flowers [3]; [4]. Treatment with HQS during simulated transport slightly extended the vase life of cut roses compares' with DW treatment [9]. . In contrast, continuous treatment with OMI/MI extended the vase life of cut roses [10]. Furthermore, treatment with glucose, CMI/MI, and AS extended vase life more than treatment with glucose and CMI/MI . In the present study, the vase life of G.jamesonii cut flower treated with CM1IMI-AS tended to be longer than that of cut flowers treated with DW (Tables 1 and 3), indicating the suitability of CMI/MI-AS for wet transport of G.jamesonii cut flower.

Treatment with sugars extends the vase life of cut flowers, but sucrose treatment often damages the leaves of some, including cut flowers [10, 14]. The degree of damage varies among Carnation cultivars . Glucose at higher than 1% damaged leaves of cut ' Rose' flowers held at 23°C in the light , yet sucrose at 4% did not visibly damage leaves held at 23°C in the dark. Damage to leaves was associated with amount of sucrose uptake in cut E. grandiflorum [4], Water uptake is much greater in the light than in the dark [14, 15]. Thus, avoidance of damage caused by sucrose solution is due to suppression of transpiration in the dark.

The vase life of Gerbera jamesonii was extended slightly by treatment with fructose or glucose during simulated transport. To improve the outcome, we investigated sucrose plus CMI/ /MI-AS treatment before and during simulated transport. Such treatment significantly extended vase life (Tables 1 and 3). The extension of vase life was greater in experiment 2 than in experiment I at 2% sucrose. This result is explained by the much greater uptake of sucrose in experiment 2 (Tables 2 and 4). The difference between experiments 1 and 2 appears to be caused by different temperatures and vapor pressure deficits during treatment, because water uptake by Gerbera jamesonii is affected by vapor pressure deficit [11]. In experiment 1, RH was not controlled, but was higher than 90%, and thus suppressed solution uptake,

The addition of ABA did not significantly extend vase life (Table 3). ABA inhibits transpiration from leaves [13], and extends the vase life of Gerbera jamsoniis however; we did not observe inhibition of transpiration by ABA during vase life, although sucrose uptake was suppressed by ABA (Table 4). Thus, the effectiveness of ABA is not attributable to the inhibition of transpiration.

5. Conclusion

In conclusion, treatment with sucrose plus CMI/M1-AS before and during transport under appropriate conditions markedly extended the vase life of G.jamesonii Sucrose treatment in the dark did not visibly damage

leaves or flowers neck. These findings suggest that sucrose plus CMI/MI-AS will be widely useful for preserving G.jamesonii.

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