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CONDITIONING GLADIOLUS SPIKES TO MAINTENANCE OF FRESH WEIGHT WITH PRE-TREATMENTS OF 8-HYDROXYQUINOLINE CITRATE PLUS SUCROSE

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ABSTRACT

Attempts were made to condition gladiolus spikes to maintain fresh weight and quality during subsequent vase-life. Spikes were conditioned in water or solutions of 1,000, 5,000 or 10,000 ppm 8-hydroxyquinoline citrate (8-HQC) with or without 4% sucrose for 24 hours. Spikes conditioned in 1,000 ppm 8-HQC plus 4% for 24 hours weighed more after 4 days of vase life than spikes conditioned in water or 8-HQC alone. Spikes conditioned with 8-HQC plus sucrose were turgid after 4 days of vase life while spikes conditioned with water showed incipient wilting.

Spikes conditioned for 24 hours in 8-HQC+ sucrose weighed more after 4 days of vase life than spikes conditioned for 2 or 6 hours. Spikes conditioned in 8-HQC at 110°F weighed more after 4 days of vase life than spikes conditioned at 74°F.

Spikes conditioned in 1,000 ppm 8-HQC+ sucrose for 24 hours then held for 3 additional days in water did not weigh as much or have as good floret quality as spikes held continuously for 4 days in 600 ppm 8-HQC+4% sucrose. Spikes conditioned in 8-HQC+sucrose had greater fresh weight than spikes conditioned in water but simulated shipping tests negated conditioning effect from 8-HQC + sucrose.

INTRODUCTION

Most of the work showing that floral preservatives benefit vase-life and quality of cut flowers has been shown in the retail floral shop or consumers home. Little information is available on post-harvest handling of cut-flowers by flower grower and the subsequent influence of handling on vase-life. Waters (12) found that storage temperatures and packaging methods exerted a major effect on gladiolus spike quality. Moisture proof wrappings were superior to paper containers. Spike keeping quality decreased as storage temperature increased from 35 to 80°F. This work agrees with other published information (4).

Although little work has been published on handling gladiolus, other cut-flowers have been studied extensively. Parvin and Krone (10) found that hardening immediately after harvest added approximately 1 day to the total life of cut roses, regardless of whether flowers were in water or preservative. They also suggested that growers, wholesalers, and retail florists use preservatives to prolong rose usefulness to the consumer. Mastalerz (9) also stressed that growers and wholesale florists should use preservatives for maximum flower life. He demonstrated that maximum carnation vase-life was attained when flowers were held continuously in floral preservatives (8). Waters (11) held chrysanthemum flowers in commercial preservatives for 12 and 24 hours, stored the flowers in commercial packages for 3 days at 40°F and replaced flowers in preservative solution or wa-

ter. He observed slight beneficial effects on keeping quality when flowers were held in preservatives for short intervals.

Mastalerz (7) showed that conditioning (hardening) cut rose flowers with water held at 122°F produced greater increases in fresh weight for 1 and 2 days than conditioning in water at lower temperatures.

One of the most recent innovations in prolonging cut-flower longevity has been a preservative containing 8-hydroxyquinoline citrate (8-HQC) + sucrose (1,2,3,5,6). This preservative is particularly effective when used continuously on gladiolus (5). Possibly 8-HQC+sucrose used for a short time during the early stages of cut flower life might condition the spike to longer life.

This paper reports the effects of conditioning gladiolus spikes with 8-HQC-sucrose early in post-harvest life in an attempt to maintain fresh weight and quality during subsequent vase-life.

Methods and Materials

Three experiments were conducted during February-April 1969 using 'White Friendship' gladiolus. Spikes from commercial fields were graded for uniformity of spike length and number of florets. Following harvest, spikes were held dry at 50°F for 2 - 6 hours prior to experimental treatments. Two-inch segments were cut from the base of the stems and spikes were placed in plastic containers (15 in. high by 10 in. diameter) containing conditioning solutions. All water and conditioning solutions were at ambient temperature (74°F) unless specified. Fresh weight of spikes, determined initially and daily, was recorded as per cent of initial weight. Flower quality was evaluated by the method previously described (5). Spikes were held in a laboratory at 74°F±2° and 50-75% R. H. Light was supplied continuously by fluorescent fixtures at 200 ft-c.

Experiment 1.—Spikes were held in water and 1,000, 5,000, or 10,000 ppm 8-HQC with and without 4% sucrose. After 24 hours, spikes were removed from treatment solutions and transferred to pint glass jars containing water. Water in jars was renewed daily at which time volume loss and absorption were determined.

Experiment 2.—Spikes were placed in water or a solution of 1,000 ppm 8-HQC+sucrose for 2, 6, or 24 hours. Solution temperatures were maintained at 74°F (ambient temperature) or 110°F. The higher temperature was maintained by placing plastic containers in thermostatically controlled water baths. Experimental design was a split plot arrangement with solution temperature as the main plot and preservative and holding time as sub-plots.

Experiment 3.—Spikes were conditioned in water or a solution of 1,000 ppm 8-HQC + 4% sucrose for 4 hours at 110°F or not subjected to any conditioning solution. After conditioning, spikes were subjected to 3 days of simulated shipping and held in water for subsequent floret quality and weight evaluations. Simulated shipping approximated time, handling, and temperatures which Florida-grown gladiolus would be subjected to during shipment to north-eastern markets. Flowers were wrapped in brown paper, placed upright in commercial cardboard shipping containers and held dry at 40°F for 3 days. Some spikes were subjected to conditioning solutions and not subjected to simlated shipping but placed directly in water. A group of spikes were not conditioned or subjected to simulated shipping, but held continuously in 600 ppm 8-HQC + 4% sucrose. Other spikes were not conditioned but were subjected to simulated shipping and held in 600 ppm 8-HQC + 4% sucrose. Treatments are summarized in Tables 3 and 4.

All data were treated by analysis of variance and statistical differences between means determined by Duncan's multiple Range Test.

Results and Discussion

Experiment 1.—Greatest differences in spike quality appeared after 4 days. Spikes held in 8-HQC + sucrose solutions for 24 hours and then transferred to water were heavier and maintained their weight longer than spikes held continuously in water (Table 1). There were no differences in fresh weight among spikes treated with various concentrations of 8-HQC when combined with 4% sucrose. Spikes held continuously in water for 4 days showed incipient wilting whereas those held in 8-HQC + sucrose were turgid. There were no differences among the treatments in number of florets per spike or days to senescence of basil floret (data not shown).

The decrease in fresh weight of spikes held continuously in water may be due to reduced water absorption (Fig. 1). Although control spikes absorbed more water initially, they ab-

Table 1. Fresh weight of 'White Friendship' gladiolus after holding spikes in 8-hydroxyquinoline citrate and sucrose solutions for 24 hrs. and then water for remaining vase-life.

Treatments		Fresh weight after[1]			
8-HQC	Sucrose	1 day	2 days	3 days	4 days
		%	%	%	%
0 (water)	0	111.3 a[2]	118.1 cd	118.7 d	109.9 d
1000 ppm	0	110.6 ab	119.1 bc	125.8 b	127.6 ab
1000 ppm	4%	107.5 c	122.2 a	130.4 a	131.4 a
5000 ppm	0	108.6 bc	116.1 de	121.6 cd	121.6 bc
5000 ppm	4%	107.1 cd	121.0 ab	128.6 ab	132.0 a
1000 ppm	0	108.4 bc	114.9 e	119.3 d	119.5 c
10000 ppm	4%	105.1 d	118.4 bcd	124.9 bc	127.7 ab

[1]Initial fresh weight equals 100%.

[2]Means in a column followed by different letters differ significantly at the 5% level.

sorbed considerably less after 4 days than spikes held in 8-HQC or 8-HQC + sucrose for 24 hours. Marousky (5) showed that 8-HQC prevents vascular blockage and allows greater solution uptake. These data suggest that a flower grower might treat spikes and "condition" them to maintain fresh weight.

Experiment 2.—Fresh weight of gladiolus spikes conditioned in 8-HQC + sucrose or water at 74 or 110°F for 2, 6 or 24 hours is shown in Table 2. Only main effects are shown; there were no significant interactions among the individual treatments. Spikes conditioned with water or 8-HQC + sucrose at 110° maintained their weight better than spikes similarly conditioned at 74°F. Spikes conditioned with 8-HQC + sucrose weighed more than spikes conditioned

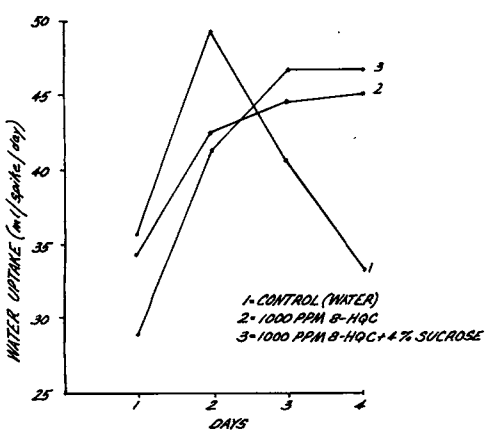

Figure 1.—Daily water uptake by cut 'White Friendship' gladiolus spikes held for 24 hours in water, 1000 ppm 8-HQC, and 1000 ppm 8-HQC+4% sucrose and transferred to water for remaining vase life.

Table 2. Fresh weight of 'White Friendship' gladiolus spikes after conditioning in 8-HQC + sucrose or water held at 74 or 110° F. for 2, 6, or 24 hrs.[1]

Treatment Main Effects	Fresh weight after 2 days	Fresh weight after 4 days
	%	%
Conditioning solution Temperature		
74°F	129.2 a	123.7 b[2]
110°F	131.6 a	131.1 a
Conditioning solution Water	129.5 a	125.7 b[3]
1000 ppm 8-HQC + 4% sucrose	131.3 a	129.1 a
Conditioning Times		
2 hrs	128.0 b[3]	124.9 b[2]
6 hrs	128.5 b	124.0 b
24 hrs	134.6 a	133.3 a

[1]Initial fresh weight equals 100%.

[2]Means in a treatment group followed by different letters differ significantly at the 1% level.

[3]Means in a treatment group followed by different letters differ significantly at the 5% level.

in water. Spikes conditioned for 24 hours in water or 8-HQC + sucrose weighed more than spikes conditioned for 2 or 6 hours.

Spikes conditioned with 8-HQC + sucrose were turgid at 5 days while those conditioned in water showed signs of incipient wilting. There were no differences in number of open florets or floret quality (data not shown). Although spikes exposed to 8-HQC + sucrose for 24 hours had the greatest increase in weight, a 24-hour conditioning may not be practical for growers who attempt to grade and ship flowers as rapidly as possible following harvest.

Experiment 3.—Spikes held continuously in 600 ppm 8-HQC + 4% sucrose (Treatment 1) weighed more after 4 and 5 days of vase life than spikes treated in any other manner (Table 3). Although spikes subjected to simulated shipping held in 600 ppm 8-HQC + 4% sucrose (Treatment 2) weighed less than spikes held continuously in 600 ppm 8-HQC + 4% sucrose (Treatment 1), they weighed more than spikes from Treatments 3 - 7. Spikes conditioned in 1,000 ppm 8-HQC + 4% sucrose but not subjected to simulated shipping (Treatment 3) weighed more after 5 days than spikes conditioned in 8-HQC + sucrose and subjected to simulated shipping (Treatment 4). Subjecting spikes to simulated shipping reduced fresh weight after 5 days (i.e. Treatment 1 compared to Treatment 2, or Treatment 3 compared to Treatment 4). However, if water was used to

Table 3. Influence of conditioning treatments, simulated shipping and holding solutions on fresh weight of 'White Friendship' gladiolus spikes after 4 and 5 days.[1]

Conditioning treatment[2]	Subjected to simulated shipping[3]	Holding solution[4]	Fresh weight after 4 days	Fresh weight after 5 days
			%	%
1. None	no	600 ppm 8-HQC + 4% sucrose	145.2 a[5]	155.8 a
2. None	yes	600 ppm 8-HQC + 4% sucrose	136.3 b	147.5 b
3. 1,000 ppm 8-HQC + 4% sucrose	no	water	129.3 c	119.1 c
4. 1,000 ppm 8-HQC + 4% sucrose	yes	water	129.2 c	109.3 d
5. Water	no	water	118.5 e	105.6 de
6. Water	yes	water	125.8 cd	103.5 de
7. None	yes	water	121.4 de	103.0 e

[1]Initial fresh weight equals 100%.

[2]Spikes were conditioned in water or 1,000 ppm 8-HQC + 4% sucrose at 110°F. for 4 hrs. Those spikes not conditioned were placed in simulated shipping or directly in holding solutions.

[3]See Text for simulated shipping procedure.

[4]Holding solutions consisted of 600 ppm 8-HQC + 4% sucrose or water.

[5]Means in a column followed by different letters differ significantly at the 1% level.

Table 4. Influence of conditioning treatments, simulated shipping, and holding solutions on floral characteristics of 'White Friendship' gladiolus spikes.

Conditioning treatment[1]	Subjected to simulated shipping[2]	Holding[3] solution	No. days to senescence of basal floret	No. florets open at time of senescence of basal floret
1. None	no	600 ppm 8-HQC + 4% sucrose	5.9 a[4]	9.6 a
2. None	yes	600 ppm 8-HQC + 4% sucrose	5.0 b	4.2 a
3. 1000 ppm 8-HQC + 4% sucrose	no	water	4.9 b	5.0 b
4. 1000 ppm 8-HQC + 4% sucrose	yes	water	4.0 d	6.7 b
5. Water	no	water	4.3 c	6.1 b
6. Water	yes	water	4.0 d	5.9 b
7. None	yes	water	4.0 d	6.8 b

[1]Spikes were conditioned in water or 1000 ppm 8-HQC + 4% sucrose or water at 110° F. for 4 hrs. Those spikes not conditioned were placed in simulated shipping or directly in holding solutions.

[2]See Text for simulated shipping procedure.

[3]Holding solutions consisted of 600 ppm 8-HQC + 4% sucrose or water.

[4]Means in a column followed by different letters differ significantly at the 1% level.

condition spikes, simulated shipment had no effect on fresh weight after 5 days. (Treatment 5 compared to Treatment 6).

Spikes held in 600 ppm 8-HQC + 4% sucrose had better floret quality and lasting ability than spikes held in water (Treatments 1 and 2 compared to Treatments 3 - 7) (Table 4). Irregardless of conditioning treatment, florets on spikes not subjected to simulated shipping lasted longer than spikes subjected to simulated shipping (Treatment 1 compared to Treatment 2, Treatment 3 compared to Treatment 4, Treatment 5 compared to Treatment 6).

These findings agree with reports on other cut flowers (8,10,11) that maximum vase-life and optimum quality are maintained when flowers are held continuously in floral preservatives.

Gladiolus conditioned in preservative by growers after harvest and held in preservative by wholesale and retail florists should deliver maximum vase-life to the consumer.

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