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Defoliation and Silverthiosulphate Pulse Treatment Prolongs the Vase Life of Cut Stalks of *Clarkia amoena*

Research Article

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Abstract

A study was conducted to examine the vase life of cut stalks of *Clarkia amoena*. Stalks were harvested at 09:00 hrs, one day before anthesis of the first mature bud and held in following test solutions: Distilled water (Controls) and Sucrose (0.05 M, 0.10 M, 0.15 M and 0.20 M). Half of the stalks were manually defoliated before their transfer to these test solutions. Another set of stalks was pulse treated with either distilled water, Silverthiosulphate (STS) (0.5 mM) or Cycloheximide (CHI) (0.5 mM) for 1 hr at 25 °C and held in distilled water or Suc (0.1 M) + $CoCl_2$ (0.1 mM). In distilled water (controls), vase life of stalks was 11.3 days. Manual defoliation of stalks held in distilled water enhanced vase life by 2-3 days. Sucrose in the holding solution had no significant effect on the vase life of either foliated or defoliated stalks. STS pulse treatment of stalks before transfer to distilled water significantly prolonged vase life by 3 days as compared to controls; whereas CHI pulse treatment reduced it by 7-8 days. Suc (0.1 M) + $CoCl_2$ (0.1 mM) in the holding solution showed negative effect, irrespective of pulse treatment with either distilled water, STS or CHI. It is suggested that the cutoff of nutrient supply is not a limiting factor for the development and opening of buds on the cut stalks and that the ethylene and leaves are involved in the senescence of cut stalks of *Clarkia amoena*.

Keywords: Cut flowers; *Clarkia amoena;* Defoliation; Pulsing; Silverthiosulphate; Vase life

Abbreviations

CHI- Cycloheximide; STS- Silverthiosulphate; Suc- Sucrose

Introduction

Clarkia amoena ssp. *amoena* (Lehm.) A. Nelson and J.F. Macbr. [synonym *Godetia amoena* (Lehm.) G. Don], belonging to Family Onagraceae, is commonly called Satin flower or Farewell to spring or simply as Godetia [1,2]. It has a considerable potential as cut flower because of its beautiful flowers. The flowers have white, rose pink or lilac-purple petals, often marked with a large deep crimson or purple spot that adds to its beauty. A variety of beautiful colors, erect racemes and the profusion with which the buds open make it a potential vase flower. Besides, it furnishes an abundance of bloom in early summer when many late spring annuals have succumbed to advancing heat [3]. The flowers bloom during May-June (in Kashmir) and the flowering period lasts for 5-6 weeks. The individual flowers have a life span of three days. This ephemeral life span of individual flowers is amply compensated by the profusion and continuity with which the buds on stalks bloom into flowers. The inflorescence being raceme, the stalk continues to produce buds during its life span of 25-35 days.

When a floral stalk is detached from the parent plant, the supply of water, carbohydrates and nutrients is cut off leading to its senescence [4]. Thus, an exogenous supply of water, sugars and nutrients becomes necessary for restoration of water balance and carbohydrate level for the respiration and normal development of

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buds and flowers. Using chemicals such as water, sugars, biocides, mineral ions, acidifiers, ethylene inhibitors, growth regulators, polyamines, metabolic and enzyme inhibitors, organic acids, salts and antioxidants, as short duration or continuous treatments, greatly improve post-harvest performance of cut flowers [5-9]. Sugars (especially sucrose) act as energy source, osmotic regulator and precursor for metabolic processes in flower development [10,11]. Exogenous sugars increase water absorption, maintain water balance and turgidity, reduce naturally occurring starch hydrolysis and lipid degradation, promote respiration and extend longevity of cut flowers [7,8,10-12]. Silverthiosulfate (STS), an ethylene antagonist, improves the longevity and quality of ethylene sensitive flowers such as *Ipomoea,* carnation, *Petunia, Phalaenopsis, Gladiolus* and sweet pea [5,12-16]. STS has been found to improve the sucrose uptake and its subsequent hydrolysis in *Gladiolus,* besides improving floret opening probably by overcoming the effects of carbohydrate depletion [13,17]. Cycloheximide (CHI), a protein synthesis inhibitor at translational level, acts as a potent inhibitor of wilting and senescence of cut flowers such as carnations, day lily, *Gladiolus*, *Iris* and *Narcissus* [18-20]. CHI has also been found to delay the protein loss in *Ipomoea tricolor* and inhibit membrane deterioration in *Ipomoea* corolla tissue and day lily [21,22]. It has been suggested that CHI blocks the synthesis of proteins and the enzymes involved in loss of membrane integrity, ethylene production or action, starch hydrolysis, fructan hydrolysis or invertase activity [5,18,23].

The present study was conducted to examine the effect of defoliation, sucrose, STS and CHI on the vase life of cut stalks of *Clarkia amoena.*

Materials and Methods

Clarkia amoena ssp. *amoena* (Lehm.) A. Nelson and J.F. Macbr [synonym *Godetia amoena* (Lehm.) G. Don], growing in the Kashmir University Botanical Garden was used in the study. The stalks were harvested at 09:00 hrs. in the morning, one day before anthesis of first mature bud and immediately brought to the laboratory, following the standard protocols [7,8,27]. In the laboratory, the basal few centimeters of the stalks were recut under water to a uniform length of 18 cm before transferring them to test solutions. The stalks were placed in conical flasks containing 200 ml of the following test solutions: Distilled water (Controls) and Sucrose (0.05 M), Sucrose (0.10 M), Sucrose (0.15 M) and Sucrose (0.20 M). Half of the stalks were manually defoliated before their transfer to these test solutions. Another set of stalks was pulse treated with either distilled water, STS (0.5 mM) or CHI (0.5 mM) for 1 hr at 25 °C and held in distilled water or Suc (0.1 M) + $CoCl_2$ (0.1 mM). Each of the aforementioned treatments was represented by three conical flasks (replicates) and each flask contained three stalks. The test solutions were renewed after every three days to minimize the microbial growth. The effects of these treatments were evaluated by keeping the flowers in the laboratory at a temperature of 25.0±2.5 °C under cool white florescent light with a mix of diffused natural light (12 Wm-2) 12 hrs a day and a RH of 60±10%, following the accepted protocols [7,8,27]. The vase life was measured as the days taken from the day stalks were kept in holding solutions to the day of wilting or senescence of the last bloomed flower on the stalk.

All the chemicals were of analytical grade. Sucrose, Silver Nitrate, Sodium Thiosulphate and Cycloheximide (CHI) were purchased from Central Drug House (P) Ltd., India. Distilled water was double distilled water. Silver Thiosulphate (STS) was prepared according to Downs et al. [28]. 0.5 mM STS was prepared by combining equal volume of 1 mM silver nitrate ($AgNO_3$) and 4 mM sodium thiosulphate ($Na_2S_2O_3$).

Results and Discussion

The average vase life of stalks held in distilled water (controls) was 11.3 days (Table 1). Manual defoliation of stalks held in distilled water enhanced vase life by 2-3 days. Sucrose in the holding solution had no significant effect on the vase life of either foliated or defoliated stalks. STS (0.5 mM) pulse treatment (1 hr; 25 °C) of stalks before transfer to distilled water significantly prolonged vase life by 3 days as compared to controls; whereas CHI (0.5 mM) pulse treatment (1 hr; 25 °C) reduced it by 7-8 days (Table 2). Suc (0. 1M) + $CoCl_2$ (0.1 mM) in the holding solution reduced vase life, irrespective of pulse treatment with either distilled water, STS (0.5 mM) or CHI (0.5 mM). Unpulsed stalks held in Suc (0.1 M) + $CoCl_2$ (0.1 mM) had significantly shorter vase life as compared to those held in distilled water. Same is true for STS pulsed stalks, which also showed shorter vase life when held in Suc (0.1 M) + $CoCl_2$ (0.1 mM) as compared to those held in distilled water.

Sucrose has been found to be very effective in delaying the senescence and improving the post harvest quality of most cut flowers [5,7,8,10-12]. However, in the present study, sucrose in the holding solution had no significant effect on the vase life of either foliated or defoliated stalks. It may be attributed to the non availability of respirable sugars to the developing buds. Vase solutions containing

Table 1: Effect of manual defoliation on the vase life of cut stalks of *Clarkia amoena,* held in distilled water (controls) and graded concentrations of sucrose*.

Vase Treatments	Vase Life Stalk^{-1} (Days)		LSD at P=0.05
	Foliated Stalks	Defoliated Stalks	
Distilled Water (Control)	11.3^{abcd}	13.7^{e}	2.3
Sucrose (0.05 M)	11.0^{abc}	13.0^{cde}	
Sucrose (0.10 M)	12.2^{bcde}	12.7^{cde}	
Sucrose (0.15 M)	9.8^{a}	11.5^{abcde}	
Sucrose (0.20 M)	10.0^{ab}	11.7^{abcde}	

*Values are means of three replicates. Lower case letters 'a-e' indicates that the treatments having different letters differ significantly at 5% level.

Table 2: Effect of pulse treatment (1hr; 25 °C) with distilled water, silverthiosulphate (0.5 mM) and cycloheximide (0.5 mM) on the vase life of cut stalks of Clarkia amoena, held in distilled water and Suc (0.1 M) + CoCl2 (0.1 mM)*.

Vase Treatments	Vase Life Stalk^{-1} (Days)			LSD at P=0.05
	Unpulsed Stalks	CHI-pulsed Stalks	STS-pulsed Stalks	
Distilled Water	11.3^{d}	3.7^{a}	14.1^{e}	0.9
Suc (0.1 M) + $CoCl_2$ (0.1 mM)	9.9^{c}	3.5^{a}	6.5^{b}	

*Values are means of three replicates. Lower case letters 'a-e' indicate that the treatments having different letters differ significantly at 5% level.

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sucrose lead to luxuriant growth of microbes, resulting in vascular occlusions of cut flowers that block their solution uptake [24]. Besides, the sugars already present in the stalks are not made available to the developing buds because of the decline of invertase activity with the age of stalks [25,26]. Invertase activity is inversely related to ethylene evolution which increases with age. Inhibiting ethylene action by its inhibitor, silverthiosulphate (STS), the activity of invertase increases thereby making respirable sugars available to developing buds [27]. This might explain why more buds developed and opened, resulting in prolonged vase life of cut stalks pulse treated with STS (0.5 mM). Manual defoliation of stalks held in distilled water enhanced vase life as compared to control. The negative effect of leaves on vase life may be due to leaves acting as sinks, leaving quite less nutrients for the growth and development of floral buds. The present study suggests that ethylene inhibitors can serve as effective pulse treatments to enhance the vase life and post harvest quality of the cut stalks of *Clarkia amoena*, which has a vast potential as cut flower.

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