EFFECTS OF PRE-HARVEST CALCIUM FERTILIZATION ON VASE LIFE OF ROSE CUT FLOWERS CV. ALEXANDER.

M.Asfanani, G. H. Davarynejad and A. Tehranifar
Department of Horticulture
Ferdowsi University of Mashhad
Mashhad, Iran.

Keywords: $CaCl_2$, rose cut flower, vase life, rose cv. Alexander

Abstract

The main problem of rose is its short vase life. Calcium is one of the important elements of cell wall that plays a major role in vase life. In similar horticultural products such as apple, pre harvest fertilization of Ca is a conventional treatment to improve storage life. In this study, a factorial experiment was conducted based on completely randomized blocks design to consider the effect of Ca on the vase life and longevity of cut flowers. The first factor was concentration in 3 levels: 0, 10 and 20 mM and the second factor was time of fertilization in 3 times as 40, 30 and 25 days before harvesting. The experiment was conducted in 3 replications. After harvesting, the cut flowers were kept in laboratory condition in distillated water. Quantitative and qualitative factors like the rate of weight lose, rate of wilting, leaf chlorophyll content, change of petal color and other visual characteristics were evaluated. The results showed that fertilization with concentration of 10 mM $Cacl_2$ at 40, 30and 25 days before harvest, improved vase life compared to untreated controls. Ten days after harvesting the cut flowers treated with Ca Cl_2 had good quality while the quality of control flowers decreased on fifth day after harvesting.

INTRODUCTION

Rose is one of the most important cut-flowers, having the highest world production. In Nederland it has the first place between 10 commercial cut-flowers (Laning, 2003). 20% of fresh flowers lose their quality while passing through the market (harvest, packaging, transportation, and sale) and a large deal of remaining flowers are sold at low quality conditions dissatisfying the consumer. Calcium has been known as one of the most important components to confer resistance and strength of cell walls. At least 60% of the calcium present in the cells is located in the cell wall (Tobias et al., 1993). Thus, the application of calcium spraying gave the result to improve the strength of plant cell wall and delay the senescence processes (Ferguson, 1984; Conway, 1987) by inhibition of ethylene synthesis (Elad and Kirshner, 1992). In addition, the calcium ion also seems to affect ethylene action on cell membranes by inhibiting ion leakage and reducing the effect of ethylene on senescence (Torre et al., 1999).

Calcium is the most important mineral in regard to fruit quality. It is present in cell walls, so its role relates to cell wall firmness which results in increased disease resistance (Tobias et al. 1993). It also plays a role in developing lateral buds and in

meristems with concurring mitoses (Tobias et al. 1993). Calcium accelerates flower opening and delays the senescence (Fergusen, 1984). Calcium treatment causes a delayed protein and phospholipids reduction off the cell membrane; and increases the ATP activity in petals (Malakooti, 2001). Calcium deficiency is frequently observed in Iranian orchards, even at calcium concentrations higher than 1.5; and this is due to slow movement of this mineral which appears only in xylems and to its non-uniform distribution in different parts of the plant. Calcium increases the storage longevity of orchard products, reportedly up to 160 days. Calcium fertilizer through summer at 7-10 days intervals brings about more frangibility and delicious fruits. In a study, calcium chloride fertilizer increased the longevity of sweet cherry to 40 days in an ordinary refrigerator. Increases in cell wall calcium cause a more firm fruit, which is preserved against microorganisms trying to enter the fruit by passing the pectin.

Calcium chelate and inhibitor of calcium channels inhibited flower bending caused by heaviness in some flower stems. In response to bending, the ethylene production increases before the bend, which is induced by calcium treatments (Ketsa and Narkbua, 2001).

Calcium chloride also increases the strength of cut-flowers' stems. Luiz et al. (2005) applied pre-harvest calcium sulfate to roses and in case of longevity and control of grey mold disease observed the best results with 10 and 20 mM calcium sulfate 24 hours prior to harvesting.

In most cases, calcium fertilizer is used to compensate the calcium deficiency of the plant. But its application on ornamental flowers can have a great positive effect towards post-harvest quality, vase life, and freshness. According to the important role of calcium in flower vase life, we tried in the present work to increase the post-harvest vase life of rose cut-flowers.

MATERIALS AND METHODS

The experiments were conducted during 2006 in greenhouse of The Orchard Organization of Astan-e-Qods-e-Razavi, Mashhad, Iran. The soil texture was loam silt with pH equal to 7.6.

Completely randomized factorial design with concentrations of calcium chloride as a first factor (0, 10, 20 mM) and the frequency of fertilization (1, 2, and 3 times at 25, 30 and 40 days before harvest) as second factor in 3 replications was used.

Flowers were harvested at 70-80 cm above ground and transferred to the laboratory of Horticultural Sciences Department. The mean temperature was 21.5 $^{\circ}$C. The light was supplied 24 hours a day with fluorescent lamps at 4 m height at intensity of 503 luxes (45.5 foot candle) in daytime and 225 luxes (21.6 foot candle) at nights. The relative humidity was about 60%. Flowers were cut into water with a height of 40 cm and all leaves except the 3 upper ones were removed. Cut-flowers were placed in distilled water. The following qualitative and quantitative factors were recorded daily: flower bud diameter, flower stem diameter, flower bud height, fresh weight of flower stem, stem dry weight, chlorophyll content of the leaves, flower bud diameter 15 day preharvest, flower bud height 15 day preharvest, flower wilting, and the intensity of petal browning.

RESULTS AND DISCUSSION

There were no significant effects of time of application and interaction between two factors. However, fertilizer concentration showed a significant ($p>\%99$) effect on flower diameter. As shown in Table 1, the maximum flower diameter was greatest in

untreated control flowers (57.68 mm) than those treatedwikth 20 mM $CaCl_2$ (45.89 mm) and 10 mM $CaCl_2$ treatments(43.08 mm). Fertilizer concentration did not have any significant effect on stem diameter (Table 1). Raese (1987) reported that calcium treatments increased the growth of apple and pear stems. Raese and Robert (1990) showed that calcium caused a 0.7 lb increase in the firmness of the fruit, and as fruit firmness is due to its woody material and cell strength, it has improved the quality of the fruit. In similar reports, mason (1979), Abbott and Canowy (1989) observed that post-harvest calcium treatments can increase fruit firmness. Canowy and Sams (1982) and Malakuti and Rasuli (2001) showed that calcium chloride fertilizer increases the strength firmness of stem in cut-flowers of gladiolus. Our results also suggest that calcium has increased stem diameter and improved flower quality, which is in full agreement with previous reports. However it appears that 10 mM calcium chloride treatments have resulted in higher values of stem diameter than those of 20 mM treatments; and it can be due to more effect of lower concentration calcium chloride on steam diameter increment.

Fertilizer concentration showed a significant negative effect on fresh weight of stems in compare with control (35.76 g) being the best, followed by 10 mM (29.56 g); and after all was 20 mM (28.88 g) treatment (Table 1).

The effect of fertilizer on dry weight was not significant. Canowy (1989) observed that post-harvest calcium treatments can increase fruit firmness which denotes a higher dry matter; and this is in agreement with our results in which control had the lowest dry weight.

It appears that different concentrations have had significant (p>%95) effects on chlorophyll content of the leaves; with the highest value to be that of control treatment (48.29), followed by 20 mM (47.99) and then by 10 mM treatments (45.53). Raese () reported that calcium treatment caused the leaves to grow greener in color and the stems to grow more. We observed the highest chlorophyll to be that of control which disagrees with Raese (1987) report. This can be due to the difference in plant material or in field and green house conditions or to different calcium concentrations.

The significant (p<5%) effect was observed as to increase the flower bud diameter pre-harvest; with the best concentration to be 20 mM (2.100 cm), followed by 10 (2.06 cm)and then by 0 mM (1.863 cm) (Table 2).

The overall observations showed that calcium treatments caused faster growth and development of buds on the plant. Calcium concentration had a significant (p>%90) effect on the height of flower bud before harvesting; with the best concentration to be 20 mM (3.058 cm), followed by 10Mm (2.873 cm) and then by 0 mM (2.780 cm) (Table 2). These results agree with Raese (1987), in which calcium treatments is reported to increase the growth of apple branches.

Luiz et al. (2005) in a study in greenhouse rose applied pre-harvest calcium sulfate reported that the best flower longevity and control of grey mold was obtained with 10 and 20 mM concentrations; which is in agreement with our results. The concentration of fertilizer has a significant (p>99%) effect on control of petal browning; with 10 mM (2.271) being the best treatment, followed by 0 mM (1.833) and 20 mM treatments (1.866) (Table 2).

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Tables

Table 1. Effect of calcium chloride concentration on quality factors on cut rose cv. Alexander

Calcium chloride concentration	Flower diameter (mm)	Steam diameter (mm)	Flower length (mm)	Fresh weight (gr)	Dry weight (gr)	Leaf chlorophylls Spat namber
0 mM	57.68[a]	6.037[a]	57.09[a]	35.66 [a]	5.063 [a]	48.29[a]
10 mM	43.08[b]	5.880[a]	52.82[b]	29.56 [b]	6.101 [a]	45.53[b]
20 mM	45.89[b]	5.800[a]	52.14[b]	28.88 [b]	6.039 [a]	47.99[a]

Means in the same column followed by the same letter are not significantly different (P<0.05)

Table 2. Effect of calcium chloride concentration on quality and quantity factors on cut rose cv. Alexander

Calcium chloride concentration	15 days Preharvest Flower diameter	15 days Preharvest Flower length	Flower wilting 4 day vase life	Flower wilting 8 day vase life	Flower browning 4 day vase life	Flower browning 8 day vase life

	(cm)	(cm)				
0 mM	1.863[b]	2.780[b]	1.887 [a]	1.500 [ab]	2.220 [a]	1.833 [b]
10 mM	2.062[a]	2.873[ab]	1.979 [a]	1.726 [a]	2.266 [a]	2.271 [a]
20 mM	2.100[a]	3.058[a]	1.962 [a]	1.397 [b]	2.243 [a]	1.866 [b]

Means in the same column followed by the same letter are not significantly different (P<0.05)