Scientific article

Storage and methyl jasmonate in postharvest conservation of roses cv. Avalanche [1]

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ABSTRACT

The use of methyl jasmonate has demonstrated its efficiency to extend the vase life of cut flowers. The objective of this study was to evaluate the effect of methyl jasmonate associated with storage at low temperatures on the postharvest quality of *Rosa* cv. Avalanche stems. The treatments consisted of 125, 250, 500 and 1000 µM of methyl jasmonate, besides the control with distilled water. The flower buds were sprayed with 4 mL of the solution, according to the treatments, and then kept in a cold chamber (1 °C) for periods of 2 and 6 days. Subsequently, the stems were taken to the postharvest laboratory at a temperature of 16 °C. Better quality, higher fresh weight and water absorption were observed in flower stems stored for 2 days. The application of methyl jasmonate caused less turgescence and greater darkening of roses. It was possible to conclude that two days is the best storage time at 1 °C and the use of methyl jasmonate does not maintain the quality of roses cv. Avalanche after harvest.

Keywords: cut flowers, floriculture, durability, floral preservative, jasmonic acid.

RESUMO

Tempo de armazenamento e metil jasmonato na conservação pós-colheita de rosas cv. Avalanche

O uso do metil jasmonato tem demonstrado sua eficiência em prolongar a vida de vaso de flores de corte. Assim, objetivou-se avaliar o efeito do metil jasmonato associado ao armazenamento em baixas temperaturas na qualidade de hastes florais de *Rosa* cv. Avalanche após a colheita. Os tratamentos foram constituídos de 125, 250, 500 e 1000 µM de metil jasmonato, além do controle com água destilada. Os botões florais foram pulverizados com 4 ml da solução de acordo com os tratamentos e após, mantidos em câmara fria a 1 °C por períodos de 2 e 6 dias. Posteriormente, as hastes foram levadas para o laboratório pós-colheita com temperatura de 16 °C. Melhor qualidade, maiores valores de massa fresca e absorção de água foram observadas em hastes florais armazenadas por 2 dias em câmara fria. A aplicação de metil jasmonato ocasionou menor turgescência e maior escurecimento das rosas. Conclui-se que o melhor tempo de armazenamento a 1 °C é de dois dias e que o uso de metil jasmonato não mantém a qualidade de rosas cv. Avalanche após a colheita.

Palavras-chaves: flores de corte, floricultura, durabilidade, conservante floral, ácido jasmônico.

1. INTRODUCTION

Rose is a species that can have an extended pot life with the use of post-harvest technologies; however, the use of toxic products for this purpose is common. The production of flowers focused on the reduction in environmental impact is a worldwide trend (RIBEIRO et al., 2016), to which sustainable agronomic practices can be applied throughout the production process, even after harvest. Natural products are an alternative to the conventional products used in the preservation of fruits, vegetables and flowers. These products extend post-harvest durability, due to their properties antagonistic to pathogenic microorganisms, reducing losses and the use of toxic chemicals (WISNIEWSKI et al., 2001).

Jasmonic acid and its jasmonate derivatives are endogenous plant regulators (LINARES et al., 2010). This molecule is related to the plant defense mechanism, inducing the expression of genes encoding specific proteins, such as protease inhibitors, enzymes involved in flavonoid production, and different disease-related proteins (CORTÊS, 2000). It is reported that the exogenous application of methyl jasmonate (200 µM) by pulsing has a post-harvest protection effect against the fungus *Botrytis cinerea* on 'Mercedes', 'Europa', 'Lambada', 'Sacha' and 'Eskimo' roses (MEIR et al., 1998). In other cultivars, such as 'Yellow', 'Orange' and 'Pink', the treatment with methyl jasmonate leads to a smaller loss of petal colors and increased pot life (MEIR et al., 2005). Spraying with methyl jasmonate (500µM) also favors the post-harvest quality of 'Vega' stems, conferring smaller fresh weight loss, lower respiratory rate and lower consumption of reducing carbohydrates (PIETRO et al., 2012).

Another factor that affects the longevity of cut flowers is temperature, fundamental for the preservation of flower

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stems, together with other factors, such as available water, moisture and ethylene action. The reduction in post-harvest temperature extends the storage period and, consequently, flower pot life (DIAS et al., 2005). In roses, the recommended mean temperature for storage and transport is of 1 to 4 °C (ALMEIDA et al., 2014).

In this context, the objective of this study was to evaluate the effect of methyl jasmonate at different doses, associated with low-temperature storage periods, on the post-harvest quality of *Rosa cv.* Avalanche flower stems.

2. MATERIAL AND METHODS

Rosa cv. Avalanche flower stems produced in a protected environment of a commercial crop without any pre- or post-harvest treatment were harvested in the morning at commercial harvest time and standardized at 35 cm in length (small stems), with three pairs of leaves. The stems were placed in cardboard boxes with the base immersed in potable water and transported to the laboratory for a period of 3 hours.

The flower stems were sprayed, covering the entire bud area with a thin layer of methyl jasmonate solution (SIGMA) at doses of 125, 250, 500 or 1000 µM, besides a control with distilled water. The methyl jasmonate solutions were prepared by dissolving the product in 0.1% Tween 20 and distilled water. The flower stems were placed in 2-liter plastic pots, containing 500 mL of potable water, covered with transparent plastic film (Figure 1A). The height of the water slide in the container covered the base of the flower stems by 8 cm.

Figure 1. Floral stems during (A) and after the treatment with metil jasmonate

Due to the volatility of the product used after the application of methyl jasmonate, the flower stems were conditioned in cardboard boxes, closed with transparent plastic film, separated by treatment (Figure 1B) and stored in a cold room at a temperature of 1 °C and RH of 90-95% for 2 and 6 days.

After the storage period, the flower stems were transferred to a laboratory room at a temperature of 16 °C and 70% RH. The temperature was kept constant by the use of an air conditioner, remaining in these conditions for 10 days, with evaluations every two days (0, 2, 4, 6, 8 and 10 days). The evaluations consisted in the analysis of water absorption, by measurements of the volume in the plastic container in which the roses were kept every two days; it was reset according to absorption. In addition, the fresh weight was evaluated by weighing the flower stems, and visual quality (darkening and turgescence of the petals, and peduncle angle), using the criteria established by Pietro et al. (2012) (Table 1).

Table 1. Rating for visual analysis of *Rosa* cv. Avalanche

Characteristics	Rate 4	Rate 3	Rate 2	Rate 1
Petal darkening	No darker petals	5 to 19% of darker petals	20 to 29% of darker petals	More than 30% of darker petals
Petal turgescence	Petals fully turgid	Slightly withered petals	Withered petals	Petals fully turgid
Angle of stalk	Upright flower	Angle between 1 to 30°	Angle between 31 to 90º	Angle greater than 90°

Source: PIETRO et al. (2012)

A completely randomized design (CRD) was used, with plots subdivided in time and factorials consisting of doses of methyl jasmonate (0, 125, 250, 500 and 1000 µM) and days of storage in a cold chamber (2 and 6), with 6 evaluation periods in the subplots (0, 2, 4, 6, 8 and 10 days). Two flower stems were used per plot, with 4 replicates. The SISVAR program was used for statistical analysis (FERREIRA, 2011).

3. RESULTS AND DISCUSSION

There were no significant differences in the fresh weight of flower stems, compared to the applied doses of methyl jasmonate, indicating that roses cv. Avalanche are not sensitive to the application of this phytohormone, as already reported for other cultivars (MEIR et al., 2005; PIETRO et al., 2012; MEIR et al., 1998).

The different storage times at low temperatures influenced the conservation of flower stems after being inserted in an environment with a temperature of 16 ºC (Figure 2). Flower stems stored for 6 days in a cold chamber showed a greater decrease in fresh weight (approximately 10 g), which was more noticeable between the sixth and the tenth day of analysis. After removal from the cold chamber, the flower stems had an increase in respiratory rate which, in turn, led to a decrease in fresh weight (CEVALOS and REID, 2001; SERRANO et al., 1992).

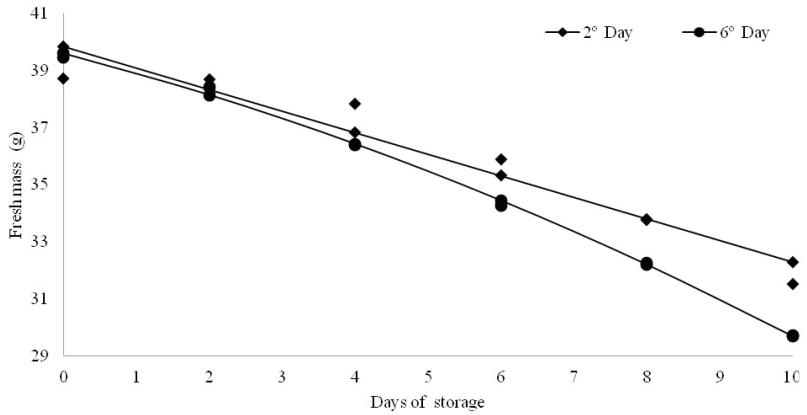

Figure 2. Fresh mass of the stems of rose cv. Avalanche storage in low temperature for two and six days. ($Y_{2\ days}$= 39,8421-0,7550*XR^2= 92,18%; Y_{6dias}= 39,5935-0,6601*X-0,0330*X2 R^2= 99,78%)

The water absorption rate also varied as a function of storage periods at low temperatures (Figure 3). Flower stems stored for a shorter time (2 days), after removal from the cold chamber, showed maximum water absorption in the first three days, with a reduction after this period.

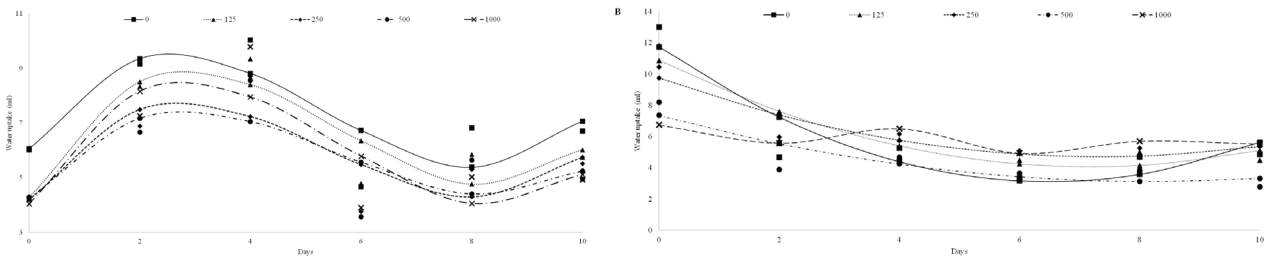

Figure 3. Water uptake in function of doses and days of storage rose cv. Avalanche stems, (A) 2 days, (B) 6 days of storage

On the contrary, when the stems were stored in a cold chamber for a longer period (6 days), a higher water absorption in the first days of evaluation was observed after returning to the temperature of 16 °C. At the time of removal from the cold chamber, the roses stored for 2 days were more turgid than those stored for 6 days (Figure 2), characterized by the lower fresh weight. As a result of the difference in water potential, there was a higher initial water absorption in these flower stems, which were less turgid. The contact with higher temperatures and consequent increase in respiration and perspiration rates may have led to a greater water consumption for rehydration of the flower stems.

Stems stored for 2 days and sprayed with distilled water (control) showed a higher water absorption during the 10 days of evaluation. In flowers stored for 2 days, the lowest water consumption on the last day of evaluation was observed in stems sprayed with 1000 µM and 500 µM of methyl jasmonate. In storage for longer period (6 days), a higher consumption occurred with the application of 500 µM methyl jasmonate.

The turgescence of flower stems (Figure 4) was higher throughout the evaluation time in those sprayed with water and stored for both 2 and 6 days. Stems receiving the application of 500 µM methyl jasmonate had lower turgidity, regardless of storage period. These results show that the response of the application of methyl jasmonate differs as a function of cultivar, since a greater turgescence was observed with the use of 500 µM of this phytohormone in roses cv. Vega (PIETRO et al., 2012). The method of application of methyl jasmonate in cv. Avalanche is also a factor to be considered, since freesia treated with this product via steam have a higher turgescence and pot life (DARRAS et al., 2005), and roses cv. Vega respond well to both pulsing and spraying (PIETRO et al., 2012).

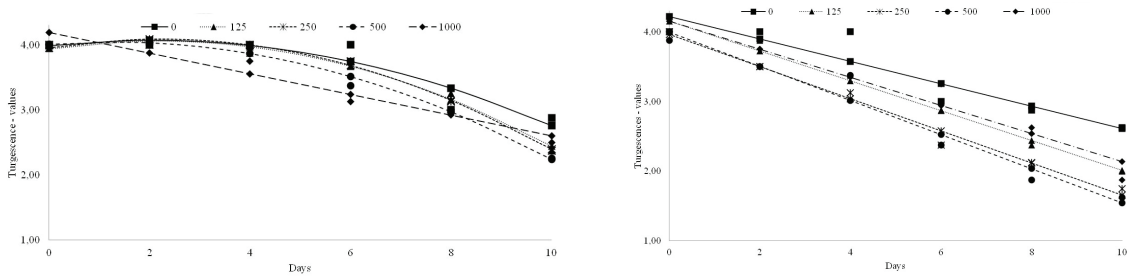

Figure 4. Turgescences values in rose cv. Avalanche stems in function of the days of storage in low temperatures and metil jasmonate concentrations. (A) 2 days, (B) 6 days of storage.

There was greater darkening of stems treated with 1000 µM, stored for 2 days at low temperatures and in stems treated with 125 µM, stored for 6 days (Figure 5). This was also observed on the tenth day in flowers receiving the application of methyl jasmonate, regardless of storage period. The control had the best means on the tenth day of evaluation for both storage periods.

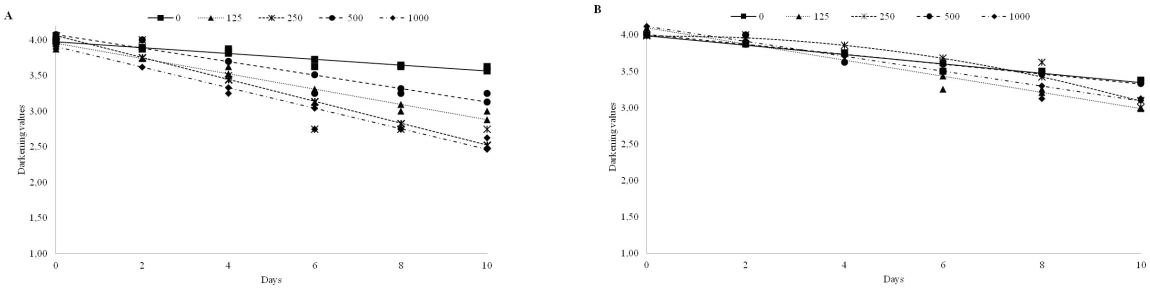

Figure 5. Darkening values in rose cv. Avalanche stems in function of the days of storage in low temperature and metil jasmonate concentrations. (A) 2 days, (B) 6 days of storage

In cultivar Vega, a better maintenance of the red color was observed with the spraying of methyl jasmonate (PIETRO et al., 2012). In the case of cultivar Avalanche, it was verified that, regardless of the doses of methyl jasmonate used, the color evaluated by petal darkening was not maintained, which indicates quality loss. This result confirms that flower varieties have different behaviors with the same treatments (NOWAK and RUDNICKI, 1990).

Considering the peduncle angle, there was no influence of the applied treatments. It was observed that the flower stems had good resistance to tipping, probably due to the peculiarities inherent in this cultivar.

4. CONCLUSIONS

In roses cultivar Avalanche, cold storage at 1 °C for two days allows for higher quality and post-harvest durability. Methyl jasmonate has no potential to be used in postharvest conservation of roses cultivar Avalanche, when sprayed.

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AUTHORS CONTRIBUTIONS

G.M.M.: Conduction and evaluation of the experiment in the laboratory; tabulation and statistical analysis; writing of the manuscript. **P.D.O.P.:** Conduction and evaluation of the experiment in the laboratory, writing and review the manuscript. **E.F.A.A.:** conduction and evaluation of the experiment in the laboratory; writing of the manuscript. **M.V.R.:** conduction and evaluation of the experiment in the laboratory. **M.O.M.:** Assembling, conduction and evaluation of the experiment in the laboratory.

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