

Longevity of *Oncidium varicosum* (Orchidaceae) inflorescences treated with 1-methylcyclopropene

Longevidade de inflorescências de *Oncidium varicosum* (Orchidaceae) tratadas com 1-metilciclopropeno

Claudia Fabrino Machado Mattiuz^{*} Ben-Hur Mattiuz¹ Teresinha de Jesus Deléo Rodrigues^{II}
Júlia de Pietro¹ Ramilo Nogueira Martins¹ Selma de Fátima Grossi¹

ABSTRACT

Oncidium varicosum belongs to Orchidaceae family and nowadays it is commercialized on large scale due to its potential as cut flower. The species distinguishes decoratively in function of the high number of flowers golden yellow that compose its great and delicate inflorescence. The hormone ethylene performs an important function in the processes related with the senescence of cut flowers, and especially in relation to orchids anti-ethylene treatments are recommended to extend the vase life. Among chemicals used today for the postharvest treatment of flowers the 1-methylcyclopropene (1-MCP) is an efficient inhibitor of autocatalytic production of ethylene. This research aimed to evaluate the effect of different concentrations of 1-methylcyclopropene (Control and 1-MCP: 250ppb, 500ppb, 1000ppb) upon physiological aspects of cut inflorescences of *Oncidium varicosum*. The best treatment was 1-MCP 1000ppb and the flowers presented larger values of water content, soluble carbohydrates, reducing sugars, carotenoids and the respiration rates were lower. These results contributed to higher quality and longer life of inflorescences.

Key words: postharvest, orchids, cut flowers, 1-MCP, ethylene.

RESUMO

Oncidium varicosum pertence à família Orchidaceae e atualmente vem sendo bastante comercializado pelo seu potencial como flor de corte. A espécie destaca-se ornamentalmente pelas inúmeras flores amarelas que compõem sua inflorescência grande e delicada. O hormônio etileno desempenha uma função importante nos processos relacionados com a senescência de flores cortadas e, especialmente para as orquídeas, são recomendados

tratamentos anti-etileno para prolongar a vida de vaso. Entre os compostos mais usados recentemente como tratamento pós-colheita, destaca-se o 1-metilciclopropeno (1-MCP), considerado um eficiente inibidor da produção autocatalítica do etileno. A presente pesquisa objetivou avaliar o efeito de diferentes concentrações de 1-MCP (250ppb, 500ppb, 1000ppb) em relação a aspectos fisiológicos de inflorescências cortadas de *Oncidium varicosum* 'Samurai'. O tratamento com 1-MCP 1000ppb destacou-se dos demais, pois as flores apresentaram os maiores teores de água, de carboidratos solúveis e açúcares redutores, de carotenoides e taxas respiratórias menores, contribuindo assim para melhor qualidade e maior longevidade das inflorescências.

Palavras-chave: fisiologia, pós-colheita, orquídeas, flores de corte, etileno.

INTRODUCTION

Oncidium is one orchid genus with more than 750 species, most occurring in South America but also in Central America and the Caribbean. The species *Oncidium varicosum* is native from the Atlantic Forest in Rio de Janeiro state, and at present time new hybrids for cut flowers are being commercialized (MILLER et al., 1996). The *Oncidium varicosum* variety is outstanding because of its large, erect inflorescence with numerous yellow, tiny flowers.

Orchid flowers are very sensitive to ethylene (HEW, 2006) and since the ethylene production

¹Departamento de Tecnologia, Faculdade de Ciências Agrárias e Veterinárias (FCAV), Universidade Estadual de São Paulo (UNESP), Via de Acesso Prof. Paulo Donato Castellane, s/n, 14884-900, Jaboticabal, SP, Brasil. E-mail: cmattiuz@gmail.com.

*Autor para correspondência.

^{II}Departamento de Biologia Aplicada à Agropecuária, FCAV, UNESP, Jaboticabal, SP, Brasil.

is an autocatalytic process, larger quantities will be produced when these flowers are in the presence of senescent flowers. Some of the main symptoms of senescence caused by ethylene and described in cut flowers are: abscission of floral buds, flowers, and leaves, epinasty, early wilting and yellowing open petals (WILLS et al., 1998).

Several compounds can be used to avoid ethylene action in cut flowers among them can be listed: STS, AgNO₃, 8-HQC. However, the applicability of 1-methylcyclopropene (1-MCP) (SEREK et al., 1995; REID, 2002) has been widely tested because it is a non-toxic volatile compound, considered an efficient inhibitor of autocatalytic production of ethylene, and it is also an alternative to commercial treatment with silver thiosulphate. 1-MCP does not produce risks to the environment. According to HEW & WONG (2004), the silver ion still is present in the postharvest solutions used largely to export cut orchids. Interesting results have been published for different floral species after 1-MCP application: *Phalaenopsis*, *Alstroemeria*, *Anthirrinum*, *Dianthus caryophyllus* (SEREK et al., 1995), *Begonia*, *Rosa*, *Kalanchoe* (SISLER & SEREK, 1997).

This research project was performed considering as working hypothesis the fact that the application of 1-MCP, which is an inhibitor of ethylene synthesis could affect physiological aspects and extend the vase life of cut inflorescences of *Oncidium varicosum* 'Samurai'.

MATERIAL AND METHODS

Inflorescences of *Oncidium varicosum* 'Samurai', with 30% of open flowers, were harvested during morning time, at a commercial point in Atibaia, São Paulo, Brazil. Each inflorescence was placed in a plastic tube with 10mL of distilled water, and packed in micro perforated plastic. The flowers were transported inside of a refrigerated vehicle (20°C) to the Plant Physiology Laboratory of FCAV/UNESP, Jaboticabal, São Paulo, Brazil. The travel lasted three hours.

The experiments were conducted on a complete randomized design under factorial scheme and the following treatments were applied: 1) control (no application); 2) 1-MCP 250ppb; 3) 1-MCP 500ppb; 4) 1-MCP 1000ppb. Three replications were used for each treatment with three inflorescences, totaling 144 inflorescences, having a total length of 50cm.

The inflorescences were placed inside a hermetic chamber and exposed to the product with the concentrations above, for 6 hours, at 22°C±1. In order to produce the desired concentrations inside the chamber, a pre determined quantity of EthylBloc®

(0.14%) was placed in a glass flask with a lid (0.16g of EthylBloc® represent 1000ppb of 1-MCP in 1m³). It was added 20mL of distilled water at 50°C and the flask was shaken until the product was completely dissolved. After that, the flask was opened inside the chamber that was immediately closed to prevent the loss of gas. During the application, the floral stalks were kept with their base inside a sealed plastic tube containing 10mL of distilled water, and later, they were transferred to Erlenmeyers with distilled water.

The inflorescences were maintained in a cold room at 22°C±0.9, photoperiod of 12 hours and 90% of relative humidity. The inflorescences remained in this ambient until the end of their vase life.

On each treatment, samples of 1g were weighed per replication in order to determine the contents of total carotenoids following HENDRY & PRICE (1993). Each sample was macerated with acetone 80% (v/v) in the presence of CaCO₃. This material was vacuum filtered and the final volume was adjusted in the proportion of 100mL of acetone (80%) per g of petals and sepals. The measurement of absorbances was performed in spectrophotometer (Beckman-DU-640) wavelengths of 480, 645 and 663nm.

The extraction of carbohydrates of inflorescences was done according to CHANTRACHIT (1999), using 2g of petals. The soluble carbohydrates content was quantified using the phenolsulphuric method (DUBOIS et al., 1956) and the reducing sugars according to the method proposed by HONDA et al. (1982).

The color evaluation of inflorescences was performed using colorimeter MINOLTA CR 200b, establishing the values of L (100=white; 0=black), a* (positive = red; negative = green), b* (positive = yellow; negative = blue). The Hue angle, or color angle, and the chromaticity were calculated using equations reported in MINOLTA CORP (1994).

The relative water content (RWC) of the flowers of *Oncidium varicosum* 'Samurai' was obtained by the collection of 10 whole flowers, on each replication. The flowers were weighed and immersed in distilled water during four hours. After this period, the flowers were weight and dried (70°C). The RWC calculation (%) was performed according to KRAMER (1983).

The number of floral buds and of flowers of the orchid stalks was recorded during the evaluations and the life time days (VLD) were finalized when 50% or more of the flowers in one inflorescence lost the quality.

The data obtained were analyzed considering that when the differences between two treatments were larger than the sum of two standard deviations they were considered significant (SHAMAILA et al., 1992).

RESULTS AND DISCUSSION

The relative water content (RWC) of *Oncidium varicosum* 'Samurai' inflorescences decreased during the days of vase life on all treatments (Figure 1). The 1-MCP 1000 ppb treatment, at 17 days of vase life, had the highest value of RWC (74.79%), improving the turgor maintenance of *Oncidium* 'Samurai' turgor. A positive water balance is a decisive factor to delay the senescence and increase the flower longevity. The application of 1-MCP (250, 500, 1000 mL L⁻¹) in three hybrids of cut orchids (*Dendrobium* 'Aron White', *Mokara* 'Jairak Gold' and *Vasotylys* 'Sakura') increased significantly the absorption of water in each inflorescence (OBSUWAN & UTHAIRATANAKIJ, 2007).

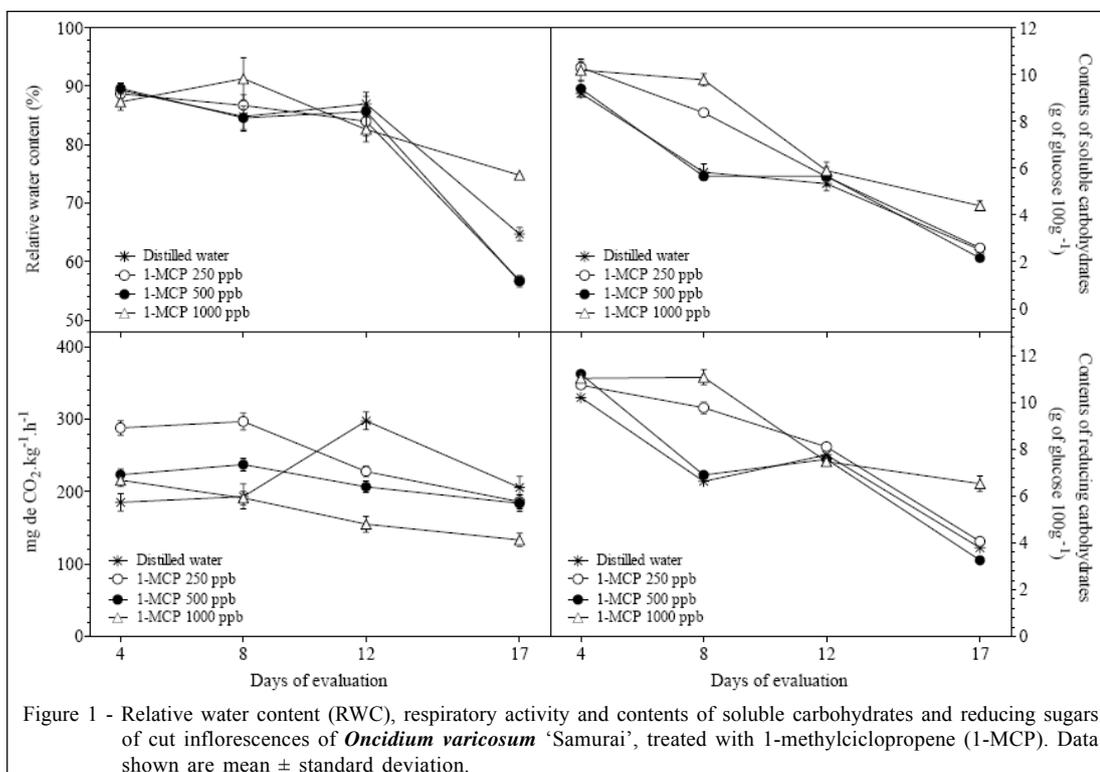
The treatment with 1-MCP 1000ppb also kept the highest values of soluble carbohydrates during the period of cut inflorescences of *Oncidium* 'Samurai', differing significantly from others at 17 VLD (4.39g of glucose 100g⁻¹). Similar results were observed analyzing reducing sugars, which inflorescences treated with 1000ppb presenting 6.52g of glucose 100g⁻¹ after 17 days from harvest (Figure 1).

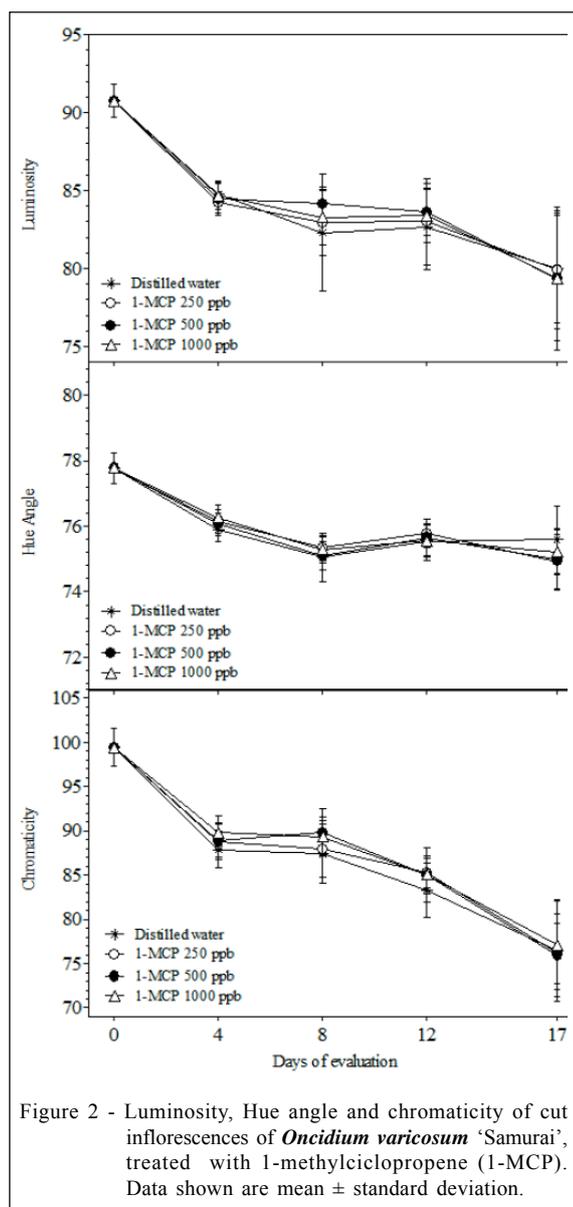
The inflorescences treated with the ethylene inhibitor the 1-MCP presented a tendency to reduce the respiration rate during the VLD (Figure 1), showing

a lower use of reserves as respiration substrate. To stay alive the flowers need a substrate to be used in the respiration biochemical process (that generates vital energy to them).

It can also be observed, in figure 1, that the inflorescences kept in distilled water presented an increased climateric followed by a decrease that possibly coincided with the consumption of the organic reserves. HEW & YONG (1994) observed that in *Oncidium* 'Goldiana' flowers, ethylene production started after a period of 100-hour-latency after the harvest and presented an increased climateric that reached a peak after 265 hours. The flowers and leaves of C3 *Oncidium* 'Goldiana' orchid showed rhythm of CO₂ production according to HEW & YONG (2004).

The evaluation of the parameters related to the coloration (luminosity, Hue angle and chromaticity) indicated a reduction of luminosity along the vase life days (VLD) (Figure 2). The initial average value was 90.73, and the final value was 78.24 (at 17VLD). Although significative differences related to the Hue angle of the flowers during the period has occurred, it is noted a tendency of color stability. Related to the chromaticity, it is noted that there was a reduction in the intensity of the coloration along the days of evaluation though significative differences has not occurred among the





treatments; the average chromaticity of the flowers initially was 99.40 and at the end it was 70.47 (Figure 2).

Considering that fading is an important factor to determine the decorative quality of cut flowers (NIIZU & RODRIGUEZ-AMAYA, 2005; HIEBER et al. 2006; DAVIES et al., 2007), several researches have been done to study changes that occur with the pigments, and consequently changes in the color during the flower VLD.

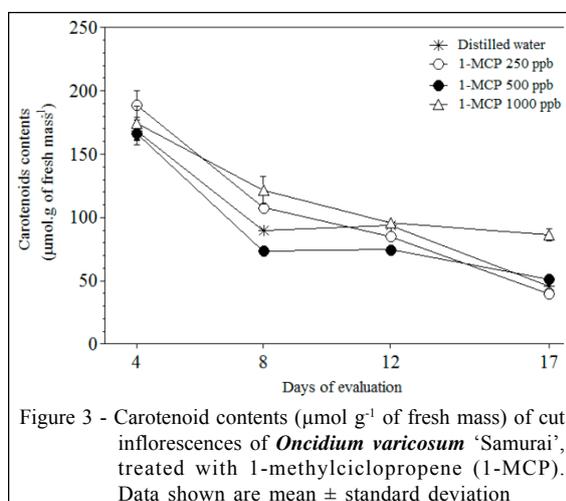
Related to the content of carotenoids of cut inflorescences of *Oncidium* 'Samurai', it can be verified a high reduction of concentrations during the period of evaluation (Figure 3). At 17 days, the major differences in effects of 1-MCP concentrations were

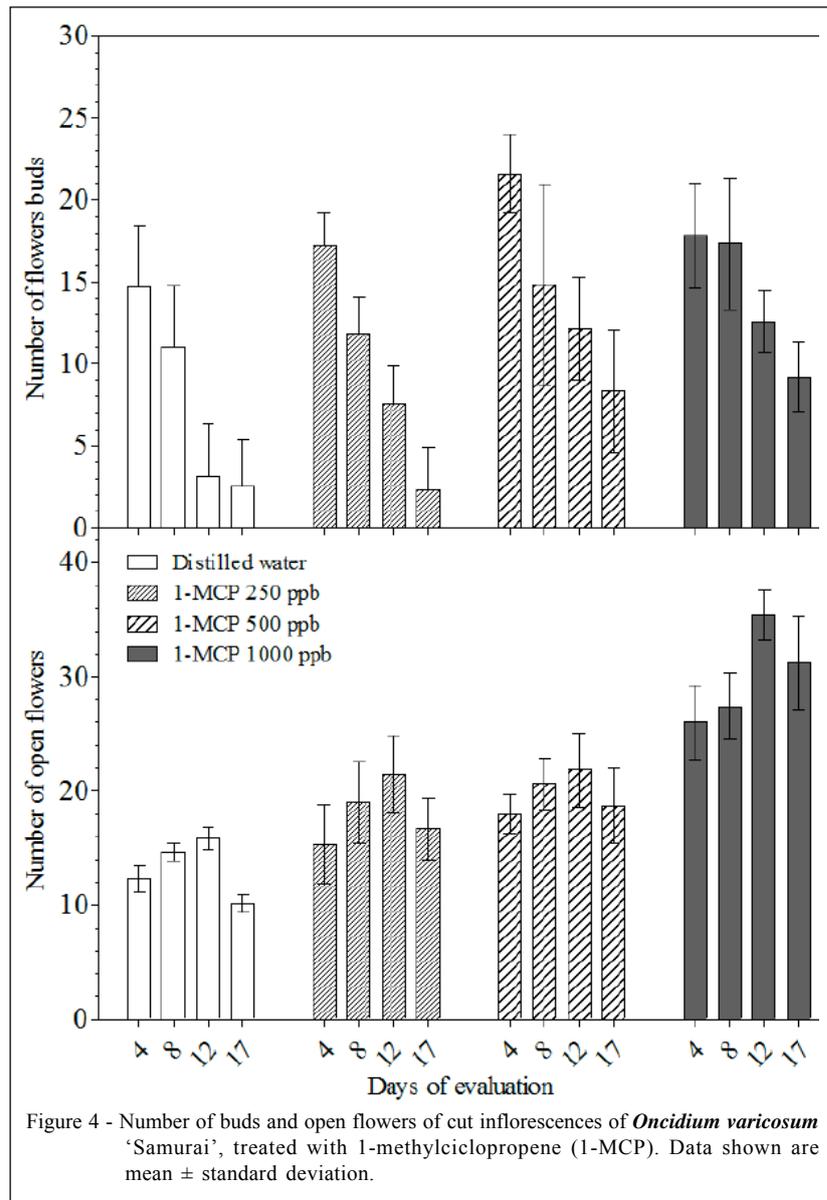
observed, mostly to the 1000ppb treatment that got the major average ($86.42\mu\text{mol g}^{-1}$ of fresh mass) and differed significantly from others. According to OBSUWAN & UTHAIRATANAKIJ (2007), the concentration of 1-MCP, needed to present some effect in blocking the action of ethylene, can vary with the species, cultivation, maturation stage and exposing temperature.

It is possible to verify (Figure 4), in relation to the treatments, that the higher 1-MCP concentration used, higher was the maintenance of the number of floral buds, and this could have been occurred due to the inhibitory effect of 1-MCP that led to a delay in the floral buds opening and/or in a minor abscission.

In the first evaluation conducted at the fourth VLD, it was found out a greater number of buds in the flowers treated with 1-MCP, indicating that this compound apparently stimulated their development. In the course of the experiment there was a decrease of the number of buds, because of anthesis and abscission. The minor number of open flowers (11.89) was counted in inflorescences of control on the 17th VDL; and the major number (27.44) in the inflorescences submitted to 1-MCP (1000) also on the 17th VDL.

The pre treatment with 1-MCP (5nL L^{-1}) of plants like *Begonia*, *Rosa* and *Kalanchoe* inhibited harmful effects of ethylene such as buds and flowers falling, leaves abscission and floral senescence, after being exposed to $1\mu\text{L L}^{-1}$ of ethylene. Plants treated with 1-MCP presented a shelf life of 14 days more than those that did not receive treatment (SEREK et al., 1994).





It can be observed, in figure 4, an initial increase (8 to 12 VLD) of the number of open flowers in cut inflorescences of *Oncidium* 'Samurai', followed by a decrease (at 17th day) due to the occurrence of flowers abscission. In flowers of *Lupinus havardii*, treated with 1-MCP, have occurred a reduction of abscission of flowers and buds, additional opening of floral buds, and a considerable increase of longevity of flowers (SANKHLA et al., 2001). Otherwise, OBSUWAN & UTHAIRATANAKIJ (2007) suggested that the vase life of cut inflorescences of *Mokara* 'Jairak Gold' and *Dendrobium* 'Aaron White' orchids after application of different concentrations of 1-MCP, could have been most affected by genetic factors. The 1-MCP

pretreatment largely prevented the bud and flower abscission in *Dendrobium* orchids inflorescences were treated for 4h at 25°C with 100-500nl l⁻¹ (UTHAICHAY et al., 2007).

The treatment with 1-MCP 1000ppb allowed a longer life of inflorescences of *Oncidium* (20 days), followed of 1-MCP 500 (16 days), and the treatments with 1-MCP 250 and control (14 days). Orchids from *Cymbidium* genus, treated with 1-MCP 500 for 6 hours, got 19 days of vase life, 12 days more than the control (HEYES & JOHNSTON, 1998). Application of 1-MCP 1000, done in *Mokara* orchid, has resulted in a higher longevity, of 25 days, significantly longer than the control that lasted 19.33 days (OBSUWAN & UTHAIRATANAKIJ, 2007).

CONCLUSION

The application of 1-MCP maintains the quality (color, turgor and brightness) of *Oncidium* flower by a longer period of time, what is highly desirable from the commercial point of view.

The treatment with 1-MCP 1000 ppb has contributed for a better maintenance of the metabolism of cut inflorescences of *Oncidium varicosum* 'Samurai' because it kept higher contents of water, soluble carbohydrates, reducing sugars and carotenoids, and led to lower respiration rates, contributing, in this way, for a better quality and higher longevity of the inflorescences (six days longer than the control).

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