# Increasing Vase Life and Quality of Dendrobium Cut Flowers using Aluminum Sulfate $Al_2(So4)_3$ and Sugar Solution

**Yusanto*, R.B. Nugroho. and Septiana**

[1]Politeknik Negeri Lampung

*e-mail: yusanto@polinela.ac.id

**Abstract**. Orchids, especially Dendrobium is a famous ornamental plant that has various flower diversity i.e. size, shape, and color. For decorative use like the display of vases and bouquets, Dendrobium cut flowers are one that consumers are interested in. This study aimed to identify the best preservative solution that can prolong vase life and the quality of Dendrobium orchid cut flowers. This study was conducted in a Floriculture rearranged in Randomized Complete Block Design (RCBD) with two factors, repeated three times. The factor I is the concentration of aluminum sulfate which consists of 4 levels: AL 0 ppm, AL 200 ppm, AL 400 ppm, and AL 600 ppm; followed with factor II is the concentration of sugar which consists of 4 levels: G 0%, G 2%, G 4%, and G 6%. Dendrobium cut flower had longest vase life (48 days) with less withered bud in 2% sugar with 200 ppm aluminum sulfate medium. 2% sugar with 200 ppm aluminum sulfate also showed the most absorbed solution which indicated that formulation was the most suitable medium for Dendrobium cut flowers. Replacing the fresh solution of 2% sugar with 200 ppm aluminum sulfate every month we guess can prolong the vase life and need to be tested in further study.

## 1. Introduction

Orchids are the largest family of flowering plants with 25,000 to 35,000 species belonging to 600 to 800 genera [1]. They are valued for their extraordinary diversity in size, shape, and color as well as their distinctive flower appeal and their high maintenance quality for up to 10 weeks. The world's orchids cut flowers trade mostly consists of 85% of the genus Dendrobium and 15% of the genera Phalaenopsis and Cymbidium, predominantly supplied from Asia [2]. Orchids cut flowers are flowers or buds that have been cut from the plant for decorative use like the display of vases and bouquets.

Dendrobium orchids are widely used in flower arrangements because of their relatively long vase life, varied flower colors and shapes, flexible flower stalk that is easy to assemble, and high productivity. The longevity of vase life of orchids cut flowers is greatly influenced by post-harvest treatment or handling. Extending vase life is an important fact-based on consumer preferences which have been optimized by several previous studies [3]. Adding chemical preservatives is a common practice for cut flowers storage [4].

Vase life of cut flowers depends on internal factors like genetic, food reserve (carbohydrates, proteins, and fats), water content, plant health, etc; and also external factors like humidity, light, and temperature. According to [5], the quality decrease of cut flowers is caused by respiration and transpiration as well as loss of food reserve during the shelf life, therefore it needs some efforts to preserve cut flowers quality.

Provision of a refreshing solution to cut flowers, better known as the preservative solution can be applied by soaking flower stalk in preservative solution with an interval of 2 – 24 hours immediately after harvest to maintain the freshness of cut flowers [3]. Generally, the preservative solution contains carbohydrates as an energy source combined with a germicide.

Carbohydrate is a major food reserve that functionally as photosynthetic precursors needed for growth, inhaled substrates, osmoregulatory, and osmoprotectants. In addition, carbohydrates can act as cellular signals by controlling gene expression. Sugar added to the preservative solution can prolong vase life in some cut flowers like *Liatris spicata* (L.) because it can maintain the respiration rate of floral tissues [6, 7].

In addition to sugar as a source of carbohydrates, the preservative solution needs to contain germicide as an anti-microbial agent. Some micro-organisms can produce ethylene or toxins that potentially reduce the quality and vase life of cut flowers. The presence of bacteria at the base of the stem will decrease the absorption of plant stems and interfere plant metabolism [8, 9]. There are several common germicide options, such as silver nitrate, hydroquinone, silver thiosulfate, and aluminum sulfate [10, 11, 12].

Previous studies reported that aluminum sulfate (Al2(SO4)3) could extend the freshness and vase life of some cut flowers like Lisianthus and also for foliage [13, 14, 3]. Besides anti-microbial agent in preservative solutions, aluminum sulfate also maintained the moisture content and reduced transpirational losses through stomata regulation [14]. This study aimed to identify the best preservative solution that can prolong vase life and quality of Dendrobium orchid cut flowers.

## 2. Method

This experiment was arranged in Randomized Complete Block Design (RCBD) with two factors. Factor I is the concentration of aluminum sulfate which consists of 4 levels: AL 0 ppm, AL 200 ppm, AL 400 ppm, and AL 600 ppm. Factor II is the concentration of sugar which consists of 4 levels: G 0%, G 2%, G 4%, and G 6%. Each treatment was repeated three times so that 48 experimental units were obtained. The data were analyzed for variance and we used LSD test at a level of 0.05 for advanced analysis [15].

### 2.1. Maintenance of orchids as broodstock

Research material had a uniform flower size and flowering time also free from disease. We used 2 g per liter of Growmore leaf fertilizer (high P and K content) plus 2 ml/l vitamins MS given twice a week and flower inducers containing BA/TDZ were given once a week. Spraying 2 g/l insecticide applied every 2 weeks.

### 2.2. Harvesting flowering plants

Flowers picked at 75% bloom, have 8 – 10 flowers, and healthy plants. Harvesting was done by cutting the ends of the flower stalks carefully using a sharp, clean and sterile cutter. To remove air bubbles, the stem ends were cut back under tap water to produce a peduncle about 12 cm from the lowest open floret.

### 2.3. Treatment and storage

The treatment solution was put into a 100 ml bottle and then the flowers were added according to the treatment, stored in the isolation space (unexposed to sunlight and water splashes). After treatment, the inflorescences were kept in a controlled environment room at 25 ± 2°C under a cool white fluorescent lamp with a relative humidity of 60 – 70%.

## 3. Results and Discussion

The combination of sugar with aluminum sulfate into the preservative solution showed a significant interaction for vase life, the total solution absorbed, and the percentage of withered flowers (Table 1). The longest flower freshness was 48 days after treatment, viz. 2% sugar with 200 ppm aluminum sulfate. It was 11 days longer than the control followed by less withered bud. This result relates to [16] reported

that a solution containing Al2(SO4)3, 8-HQS, and sugar was able to prolong the vase life of three different hybrid Dendrobium orchids.

Table 1. The results of vase life, absorbed volume, blossoms, and withered buds

| Concentration Alumunium Sulfat (ppm) | Concentration Sugar (%) | Vase life (day) | absorbed volume (ml) | Blossoms (%) | Withered buds |
|---|---|---|---|---|---|
| 0 | 0 | 37 d | 23,33 c | 0,71 | 38, 41 e |
| | 2 | 39 cd | 26,67 d | 1,89 | 24,81 bc |
| | 4 | 39 cd | 20 b | 1,05 | 24,93 bc |
| | 6 | 37 d | 21,67 bc | 1 | 25,65 c |
| 200 | 0 | 43 bc | 23,33 c | 2,65 | 24,93 bc |
| | 2 | 48 a | 26,67 d | 0,67 | 19,00 a |
| | 4 | 44 b | 21,67 bc | 1,67 | 19,53 ab |
| | 6 | 43 bc | 21,67 bc | 1,65 | 22,89 bc |
| 400 | 0 | 38 d | 21,67 bc | 1,38 | 23,01 bc |
| | 2 | 46 ab | 25,00 cd | 1,83 | 19,81 ab |
| | 4 | 44 b | 18,33 ab | 1,26 | 22,73 b |
| | 6 | 42 bc | 16,67 a | 1,77 | 24,53 bc |
| 600 | 0 | 40 cd | 18,33 ab | 1,62 | 32,23 d |
| | 2 | 41 cd | 15 a | 1,38 | 25,73 bc |
| | 4 | 42 bc | 26,67 d | 0,81 | 25,80 c |
| | 6 | 40 cd | 25,00 cd | 1,01 | 31,70 d |

The reason why 2% sugar with 200 ppm aluminum sulfate affected the longest vase life with less withered bud was that solution was the most absorbed compared to other treatments. The higher absorption, the more energy obtained. It indicated cut flowers fit that solution and can maximize the solution content. Instant energy from sugar prolong vase life and flowers need. It was relevant with [17] who reported that sugar is a carbon source that plays an important role in petal growth and inhibits aging. Also, flower blooms can be used as an indicator that plant tissues are still carrying out metabolic activities and they gradually wilt due to the limited supply of food reserves in plant tissues, water, and external nutrition. In addition, anti-microbial agents sourced from aluminum sulfate contribute to the free disease of cut flowers.

Adding more sugar wasn't deal longer vase life, on the contrary, it slightly reduce vase life compared to 2% sugar added. Adding a lot of sugar increase viscosity of the solution, thereby interfering with the diffusion and osmosis processes in cut flowers. [18] reported that the inhibition of the absorption of the solution causes flower wilt quickly. Also, high concentration of aluminum sulfate is unnecessary to cut flowers. It can reduce pH solution and toxic for some plants [19]. 4.8 – 5.8 is the best suitable pH medium for Dendrobium orchids [20], so that, adding a lot of aluminum sulfate potentially causes an unsuitable medium for Dendrobium orchids. That condition can reduce vase life and the number of wilt flowers.

## 4. Conclusions

Sugar and aluminum sulfate in preservative solution proven to prolong vase life and quality of Dendrobium cut flowers. For the specific concentration, we recommend 2% sugar with 200 ppm aluminum sulfate because it has a good result for Dendrobium cut flowers vase life, moreover the most economical treatment.

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