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Development of Longevity of *Allamanda* Flower as Affected by Gibberellic Acid and Aluminium Salt

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ABSTRACT

Allamanda is an ornamental plant cultivated for their large, yellow and pink colorful flowers in the garden, office and home stead as well as in the occasional place. It makes attractive to the environmental beautification for its color and fragrant. The study was conducted with yellow type of *Allamanda* flower (*Allamanda cathartica*) to investigate the effects of gibberellic acid (GA3) and aluminium salt (aluminium sulfate) on the longevity (vase life and senescence) of the flower. Three types of treatments were used water control, gibberellin (GA3) 100 ppm and aluminium sulfate 150 ppm. Gibberellic acid (GA3) and aluminium sulfate were swabbed the bud twice a week for 2 weeks. The fresh weight was higher in the aluminium sulfate 150 ppm than gibberellin (GA3) 100 ppm and control. The decreasing trend of fresh weight was found in the case of all treated flowers. The lowest fresh weight loss was found in the aluminium sulfate 150 ppm then gibberellin (GA3) 100 ppm. Flowers treated with aluminum sulfate (8.19%) absorbed more water than those in GA3 and water control treated flower. Water uptake percentage was the highest in the aluminum sulfate treated flower followed by GA3 and water control treated flower. Senescence was delayed 5 days for aluminium sulfate 150 ppm and 1day for gibberellin (GA3) 100 ppm compared to control flower. Compare to control flower, the vase life of both aluminum and gibberellin treated-flowers were much longer (8.5 and 5.5 days) than control (4 days). The results showed that the best treatment for vase life and delay senescence was Aluminium sulphate 150 ppm and then gibberellin (GA3) 150 ppm.

Key words: *Allamanda*, aluminium sulphate, GA3, senescence, vase life

INTRODUCTION

Allamanda is a genus of flowering plants in the dogbane family, Apocynaceae. They are native to the Americas, where they are distributed from Mexico to Argentina. *Allamanda* species are familiar as ornamental plants cultivated for their large, yellow and pink colorful flowers and make attractive to the environmental beautification (De Souza-Silva and Rapini, 2009). The *Allamanda* vine and flower perfectly combine the beauty and make them garden favorite. *Allamanda* flower is very fragrant, mostly yellow and environmental friendly (Antosh, 2012).

Allamanda is used throughout the tropics as ornamentals. *Allamanda* has been used in medicinal and ornamental field. For medicinal purpose, the milky sap of *Allamanda* possesses antibacterial and possible anticancer properties. Besides, the leave, roots and flowers have been used in the preparation of a powerful cathartic that helps in bowel movement. It also has the possibility as anti-dermatophytic agent and has effects on gastrointestinal motility (Kampanilya, 2013). The plant hormones may have a profound effect on the growth and the development of the plant organ. Generally, plant hormones control the plant growth and the development by affecting the division, elongation and differentiation of the cells (Hossain *et al.*, 2008; Hossain, 2012).

Treatments with gibberellins would be substituted for the photoperiodic (long or short day) or temperature requirements (Brian, 1959). Gibberellin acts as the inducer, as its presence allows the enzyme induction of amylase, which can break down starch into a sugar to be used in the embryo. Sugar is used in the plant to synthesize proteins and break out of dormancy (Jones and Hill, 1993). Some of the physiological processes stimulated by gibberellins are to stimulate stem elongation by stimulating cell division and elongation, stimulates flowering in response to long days, breaks seed dormancy in some plants that require stratification or light to induce germination, induces maleness in dioecious flowers (sex expression) and can delay senescence in leaves and citrus fruits (Hossain *et al.*, 2006).

A study had been carried out and reported that aluminum sulfate inhibited water loss and thus, maintained the freshness of the flowers (Liao *et al.*, 2000, 2001). Senescence represents the last stage of flower development. While, the senescence of whole plants and plant organs occurs naturally, environmental and biotic stresses during production, in retail environments and in the home and garden can accelerate senescence. Symptoms of senescence that reduce the quality of ornamentals include flower wilting, abscission of flower parts and fading of blossoms (Hossain *et al.*, 2008). *Allamanda* plants are beautiful fragrant plants to grow in the garden or around the house. Because of the beauty, the cut flowers can also be used as a vase decoration and some people even slipped it between the hairs. However, the longevity of cut flowers is very short. Plants with delayed senescence would produce cut flowers with longer vase lives with enhanced bloom displays. Thus, the aim of this research project was to determine the effect of gibberellin (GA3) and aluminium sulfate on the vase life and senescence of *Allamanda* flowers for using the commercial purpose.

MATERIALS AND METHODS

Plant material: The experiments were performed with yellow type of *Allamanda* flower (*Allamanda cathartica*) and *Allamanda* plants growing in the orchid of Institute of Biological Science, University of Malaya were used for the experiments. The experiment was set in the field during flower initiation. Then after full blooming flowers were harvested and set in the laboratory for vase life determination.

First part in the field: Nine branches with similar length of 20 cm of *Allamanda blanchetii* were selected for this experiment. Three types of treatments were used; control, gibberellins 100 ppm and aluminium sulfate 150 ppm. The concentration for both gibberellin and aluminium sulfate was 10 mg/100 mL (100 ppm). For each treatment, three replicates were prepared. The entire branches were labeled according to their treatments. Gibberellins acid (GA3) and aluminium sulfate were swabbed the bud twice a week for 2 weeks. Every day observation was made and data were taken weekly.

Second part in the laboratory (vase life measurement): Nine complete blooming flowers of *Allamanda cathartica* were picked and the fresh weight of each flower was measured. The concentration for both gibberellin and aluminium sulphate was 10 mg/100 mL (100 ppm) and 15 mg/100 mL (150 ppm), respectively. Several parameters were involved: Fresh weight loss, water uptake, senescence and vase life. The samples were placed at room temperature. The data for all parameters were measured daily. The volume of water uptake was calculated by subtracting the difference in volume of solution:

$$\text{Water uptake (\%)} = \frac{\text{Weight at 10th day} - \text{Weight of final day}}{\text{Weight at 10th day}} \times 100$$

Fresh weight loss was calculated by:

$$\text{Weight loss (\%)} = \frac{\text{Weight at 10th day} - \text{Weight of final day}}{\text{Weight at 0th day}} \times 100$$

Senescence evaluation: The characterization was observed by color changes and wilting. Flower status (flower wilting) was observed every day. Percent petal wilting was calculated by observing the total petal area divided by wilted petal area multiplying by 100.

Vase life evaluation on gibberellins and aluminum sulfate: Cut flowers were placed into the vials with different treatments (3 flowers/replicates for each treatment). The aqueous solutions of aluminum sulfate and gibberellins used in the experiment were 15 mg/100 mL and 10 mg mL⁻¹, respectively. Distilled water was used for as control. The vase life of cut flowers was completed when the petals or stem below the flower head lost turgor.

RESULTS AND DISCUSSION

Fresh weight: From the graph, the fresh weight for all treatments was higher from the initial weight within the first several days before it started to decrease (Fig. 1). All flowers, regardless of the treatment, reached its highest weight at day 1 before decreased over time. The fresh weight was dependent on efficiency of water uptake. The sudden increase at the first day might be due to alteration to the treatment condition. The solution gave sudden shock to the cut flower and thus it absorbed more water and led to increase in sudden fresh weight.

Fresh weight loss: Fresh weight loss from cut flowers treated with aluminum sulfate (8.88%) and gibberellin (28.92%) was lower than that of water control (50.63%) (Fig. 2). Cut flowers absorbed

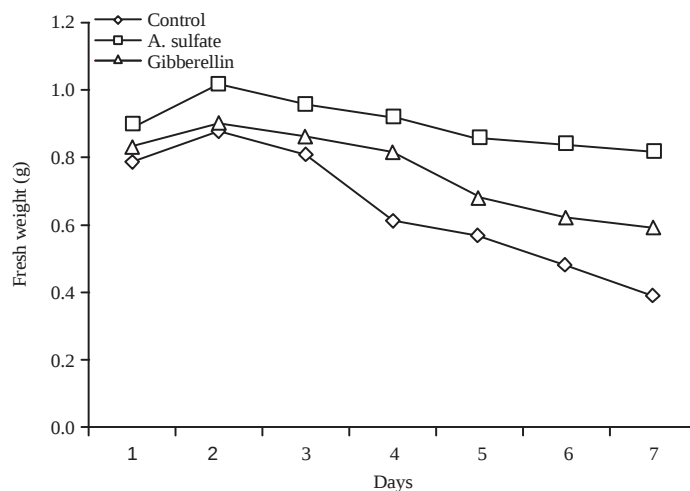


Fig. 1: Effect of different treatments on fresh weight (*Allamanda cathartica*)

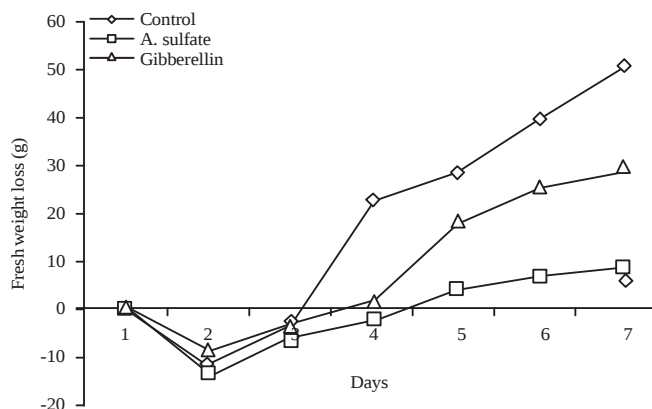


Fig. 2: Effect of different treatments on fresh weight loss (*Allamanda cathartica*)

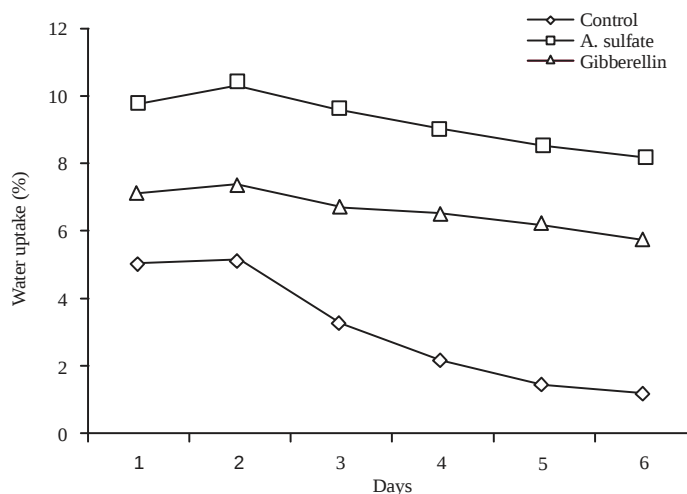


Fig. 3: Effect of different treatments on water uptake percentage (*Allamanda cathartica*)

water to preserve its freshness. However, the transpiration process by the flowers resulted in loss of its weight. The result here suggested that transpiration was inhibited by aluminum sulfate.

Water uptake: Cut flowers treated with aluminum sulfate (8.19%) absorbed more water than those in water controls (only 1.17%) (Fig. 3). This led to less decreased in fresh weight. Water uptake for gibberellins (5.8%) was also higher compared to control. Water uptake was dependent on senescence. Here, aluminum sulfate and gibberellin acted as ethylene inhibitor. As a result, the senescence was delayed and thus the cut flowers were able to consume more water to retain its freshness.

From the result, it was observed that the treatment of aluminium sulfate had managed to delay the senescence effect (Fig. 4). At day 4, compared to control-treated flower (100% senescence) and gibberellins-treated flowers (73.33), cut flowers of aluminium sulfate only showed 40% senescence. Senescence of petals was associated with increased in ethylene production. Aluminium sulfate and gibberellins acted as ethylene inhibitor. It thus resulted in delay and suppression of the senescence effect. From the result, it could be concluded that the effect of aluminium sulfate as inhibitor was much stronger.

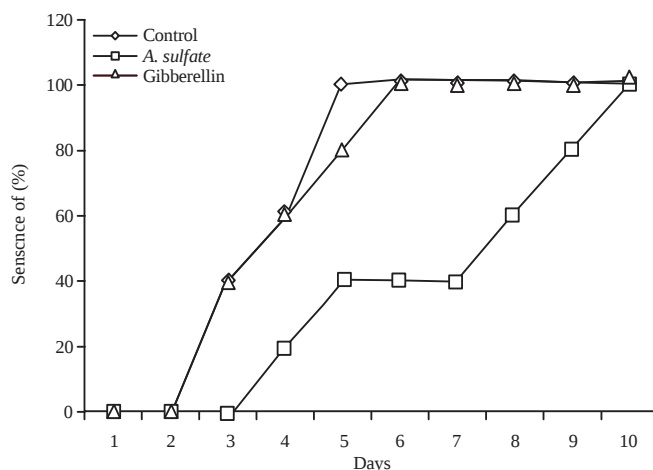


Fig. 4: Effect of different treatments on flower senescence (*Allamanda cathartica*)

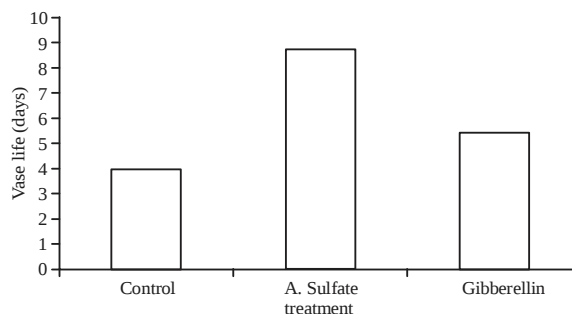


Fig. 5: Effect of different treatments on vase life (*Allamanda cathartica*)

When all the petals reach 100% senescence, it means that the flower had reached the end of its vase life. Compare to control flower the vase life of both aluminum and gibberellins treated-flowers were much longer (Fig. 5). Treatment with aluminum sulfate had managed to extend the freshness of the flower up to 8-9 days while for gibberellins, it was extended to 5-6 days. Figure 6a and b show the effect of longevity at different concentration at different days.

Vase life: There was a significant difference in fresh weight and water uptake between cut flowers placed in aluminum sulfate at 150 mg L^{-1} and those in distilled water. The decline in fresh weight on the 8th d was due to flower wilting and transpiration. Cut flowers treated with aluminum sulfate absorbed more water than those in water controls. Van Doorn (1997) reported that vascular blockage in water controls caused water deficit. Water uptake allowed more increase in fresh weight. The weight loss from cut flowers treated with aluminum sulfate was lower than that of July 7, 2015 water controls. The result from the Fig. 2 suggested that transpiration was inhibited by aluminum sulfate. It was supported with a study by Hampp and Schnabl (1975) where it was reported to inhibit transpiration from leaves a main source of water loss in cut flowers. Since, these compounds inhibit transpiration from leaves, we speculate that transpiration rate may be related to cultivar variation in the vase life of cut flowers. The finding that aluminum sulfate and 2-hydroxy-3-ionen chloride polymer, which inhibit transpiration, extend the vase life of cut roses. Senescence represents the last stage of flower development. Ethylene or ethylene-releasing



Fig. 6(a-e): Photograph shows the vase life of flower at different treatments (a) Control, (b) Aluminium sulfate, (c) Gibberellin, (d) Flower at day 6 and (e) Flower at day 9, Lane1-3: Control, Lane4-6: Aluminium sulfate and Lane7-9: Gibberellin

compounds generally promote senescence. Symptoms of senescence that reduce the quality of ornamentals include flower wilting and fading of blossoms. Flower petals provide an excellent model system for studies of senescence because they have a finite lifespan and their death is under tight developmental control. Floral senescence in many species is accelerated by the plant hormone ethylene. In these flowers, petal senescence is associated with an increase in endogenous ethylene production and inhibitors of ethylene biosynthesis and action delay senescence. Pharos and King (1985) stated that the essential steps of the pathway have been completely identified in cut flowers. The ACC (1-aminocyclopropane-1-carboxylic acid) content, ACC synthase, activity of

the Ethylene-Forming Enzyme (EFE) and of 1-cyanoalanine synthase have all been shown to rise coordinately with the onset of the ethylene climacteric burst in various flower parts.

Cytokinins and gibberellins have been reported in several studies to improve the post harvest vase life of many cut flowers (Moneruzzaman *et al.*, 2010). The vase life of cut *Allamanda* flowers was significantly extended when using 150 ppm concentration of aluminum sulfate. Previous result from Liao *et al.* (2000) showed that concentration of 150 mg L⁻¹ managed to prolong the vase life for 15 days compared to other concentration of aluminum sulfate solution was 8-9 days, whereas the vase life of the water controls was only 4 days. It thus can be concluded that aluminum sulfate has proven its effect to prolong the vase life of flowers. In the study, Gibberellin was able to extend the vase life for 5-6 days. Here, GA₃ delayed protein degradation used in the synthesis of chlorophyll as evidenced by the significant retention of leaf nitrogen in previous study of *Alstroemeria* cut flowers (Mutui, 2001).

Longer vase life of *Allamanda* flower makes the environmental beautification for long lasting. It was reported that *Allamanda* species are familiar as ornamental plants for their nice looking of yellow and pink colorful flowers and make attractive to the environmental beautification (De Souza-Silva and Rapini, 2009). The *Allamanda* vine and flower perfectly combines the beauty and making them garden favorite. *Allamanda* flower very fragrant, mostly yellow and environmental friendly (Antosh, 2012). Present research is supported by these literatures.

CONCLUSION

From this study result showed that the best treatment was aluminium sulphate 150 ppm to increase vase life and delay senescence. The second highest was gibberellin (GA₃). Here, the effect of aluminium sulfate was proved to preserve the ornamental qualities of *Allamanda* cut flowers. Thus, aluminum sulfate in the vase solution could be applied to commercial floral preservative for cut flowers. In addition to that it can be used to increase the beauty to the environment keeping long longevity of the *Allamanda* flower.

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