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VASE LIFE RESPONSE OF TUBEROSE (*Polianthes tuberosa* L.) DUE TO GIVING GA_3 AND SUGAR

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Abstract. This study aims to determine the concentration of GA_3 and the addition of sugar to the freshness of cut tuberose flowers. The research was conducted from May to June 2020, in Wano Village, Japara District, Kuningan Regency. The research method used was a Completely Randomized Factorial Design. The treatment consisted of 2 experimental factors, the concentration of GA_3 with 4 treatment levels G0 (0 mg/l), G1 (50 mg/l), G2 (100 mg/l), and G3 (150 mg/l) with sugar concentration 4 treatment levels S0 (0 g/l), S1 (25 g/l), S2 (50 g/l), and S3 (75 g/l). Observations made were the decrease in fresh flower weight, number of blooming flowers, wilting period of flowers, total solution absorbed, and flower freshness period. The results showed that no interaction between GA_3 and sugar treatments in all observation components. The GA_3 treatment had no effect on all components of the observation, but the addition of sugar affected the reduction in fresh weight, wilting time of flowers, total solution absorbed and flower freshness. Treatment S3 (sugar 75 g/l) had the best results at a wilting period of 6.96 days, a total of 16.42 ml of absorbed solution, and a freshness period of 11.25 days.

Keywords: Tuberose Cut Flowers, GA_3, Sugar, Freshness Period.

INTRODUCTION

The tuberose flower (Polianthes tuberosa L.) is a type of cut flower that is popular in Indonesia. Its white flowers with a distinctive fragrance are its own attraction. One of the obstacles that often arises in the display of cut tuberose flowers is that the freshness period is not very long. Tuberose flower buds that have bloomed will wither in 2 – 3 days, and the freshness of cut tuberose flowers of the Dian Arum cultivar can last for 4 – 6 days (Rukmana, 2017). There are several factors that cause the freshness of cut flowers to decrease, including decreasing carbohydrate levels, increasing temperature, respiration, water stress, attack by microorganisms and increasing ethylene levels. Efforts to extend the

freshness of cut flowers are usually done by soaking the flower stalks in a preservative solution (pulsing and holding) and spraying the preservative solution on the cut flowers.

Gibberellin is a growth regulator that is commonly used to increase the freshness of cut flowers. The use of exogenous gibberellin in gerberas can encourage an increase in reducing sugars originating from carbohydrate hydrolysis, increase the osmotic potential value of flower buds and flower stalks, increase turgidity and freshness (Emongor, 2004). Gibberellins can increase stress tolerance, antioxidant activity, and freshness (Saeed, 2014). One type of gibberellin that is widely used is GA_3.

Carbohydrates play an important role in the respiration process, namely as a substrate. One type of carbohydrate that is easy to obtain is sucrose. Apart from being a respiratory substrate, sucrose also plays a role in maintaining osmotic pressure so that water absorption runs well (Yuniati, 2011). One ingredient that contains sucrose is white crystal sugar (GKP).

Even though they have been separated from the main plant, cut flowers still carry out metabolic processes, namely respiration. The respiration process that occurs in cut flowers can cause the freshness of cut flowers to decrease so that they wilt quickly and do not last long, this causes cut flowers to rot quickly and not look attractive. To reduce the respiration rate of cut flowers, research was carried out to see whether the administration of GA_3 and sugar could reduce the respiration rate so that cut flowers could have a longer freshness period.

LITERATURE

Tuberose cut flowers are one of the most popular cut flowers in Indonesia because they have a beautiful white color and distinctive aroma. Cut tuberose flowers have a short freshness period. According to (Rukmana, 2017), tuberose flower buds that have bloomed will wither in 2 – 3 days, and the freshness of cut tuberose flowers of the Dian Arum cultivar can last for 4 – 6 days. To extend the freshness of cut flowers, treatment is usually given in the form of preservatives containing carbohydrates, germicides and growth regulators by soaking or spraying.

Growth regulators (ZPT) are given to inhibit ethylene production in cut flowers. One of the PGRs that can inhibit ethylene production in plants is gibberellin. One type of gibberellin that is widely used is GA_3. According to (Hassani & Alimirzaii, 2017) spraying GA_3 with a concentration of 1.5 mM (519 mg/l) and 15 mM calcium chloride (1,680 mg/l)

can increase the freshness of cut flowers of the Velvet rose cultivar by maintaining the water balance on the flower stalks.

Meanwhile, according to the research results of (Simoes et al., 2018), showed that treatment of GA_3 144 µM (49.824 mg/l) + Spermine (SPM) 2 µM (0.404 mg/l) by spraying effectively increased the freshness of cut flowers of the Arizona cultivar anthurium placed at room temperature 20^{o}C. Meanwhile, according to (Sajid et al., 2018), spraying GA_3 with a concentration of 100 mg/l on chrysanthemum flowers can increase the freshness period to 37.15 days.

Food reserves in the form of carbohydrates will be used as a substrate for the respiration process in cut flowers. Therefore, exogenous carbohydrates need to be given to cut flowers as a food reserve supply. One source of carbohydrates that is easy to obtain and has an affordable price is white crystal sugar (GKP) which contains sucrose.

Several research results have shown that adding sugar can extend the freshness of cut flowers. According to (Wahyuni, 2010), sugar concentration alone does not have a significant effect on the percentage of flowers blooming and the time the flowers bloom, but has a significant effect on the freshness of cut roses.

The research results of (Sivastava et al., 2015) showed that applying sucrose at a concentration of 4% (40 g/l) to cut chrysanthemum flowers could prevent a decrease in fresh weight, increase solution absorption, increase flower diameter, and extend the freshness period compared to controls.

Meanwhile, according to (Yuniati & Alwi, 2011), 5% sucrose treatment (50 g/l) with a soaking time of 2 hours was able to maintain the freshness of Nerium oleander L. cut flowers for up to 16 days, increasing the percentage of flower blooms and water absorption volume and reducing the number of wilted flowers. . The same thing was also stated by (Chaudhary & Khanal, 2018), that giving 6% (60 g/l) sucrose solution with distilled water can increase the absorbed solution, prevent a decrease in fresh weight, increase flower diameter, slow bending of the flower neck, and increase the freshness period. rose cut flowers.

It is hoped that the provision of GA_3 and sugar will work together to increase the freshness of cut flowers. (Ahmadi & Hassani, 2015) stated that the GA_3 40 mg/l pulsing treatment accompanied by 2% sucrose holding treatment (20 g/l) could increase the freshness period and quality of cut flowers of the Velvet cultivar rose by increasing the total absorbed solution, fresh weight, diameter. flowers, and leaf chlorophyll index.

According to (Han's, 2003) research results, it also shows that soaking Lily Stargazer flowers in a sugar solution with a concentration of 2% (20 g/l) and spraying BA (benzyladenine) and GA_{4+7} solutions of 50 mg/l each can maintain the color of the flower crown. and leaf quality.

METHOD

The research was carried out from May to June 2020, in Wano Village, Japara District, Kuningan Regency, which is at an altitude of 351 m above sea level. The research was carried out in a private house. The room used measures 2 m x 3.5 m, without air conditioning, and has good ventilation. The materials used in this research were cut tuberose flowers of the Dian Arum cultivar, GA_3, granulated sugar, clean water, styrofoam, mica and rubber. The tools used are thermometers, hygrometers, digital scales, measuring cups, pipettes, porcelain pestles, buckets, pressure sprayers, pH meters, stirrers, knives, calipers, rulers, cameras, stationery, and others.

The research method used was the Factorial Completely Randomized Design method, with 2 experimental factors. The first factor is GA_3 concentration with 4 treatment levels, namely G0 (0 mg/l), G1 (50 mg/l), G2 (100 mg/l), and G3 (150 mg/l). The second factor is sugar concentration with 4 treatment levels, namely S0 (0 g/l), S1 (25 g/l), S2 (50 g/l), and S3 (75 g/l). GA_3 was applied by spraying while sugar was applied by pulsing for 2 hours. The treatment was repeated 2 times so that there were 32 experimental units. Data were analyzed using variance and followed by Duncan's multiple test at the 5% level.

The research implementation consisted of preliminary research activities and main research. Preliminary research aims to determine the amount of spray volume that will be used when applying GA_3 in the main research. Observations in the main research included a decrease in the fresh weight of flowers, the number of flower buds in bloom, the wilting period of the flowers, the total water absorbed and the freshness of the flowers.

DISCUSSION

Determination of Spray Volume

The average spray volume for spraying five stems of cut tuberose flowers was 113.3 ml (Table 1). So the spray volume per stem is 22.7 ml which is rounded up to 23 ml.

Table 1. Observation of spray volume

Replication	Initial Volume (ml/ml)	Final Volume (ml/ml)	Used Volume (ml/ml)
1	500	388	112
2	500	380	120

3	500	392	108
Total			340
Average			113,3

Fresh Weight Reduction

GA_3 and sugar treatments did not have an interaction effect on reducing the fresh weight of cut tuberose flowers. Independently, only the sugar treatment had a significant effect on reducing the fresh weight of tuberose flowers, while the GA_3 treatment did not (Table 2).

Table 2. Independent Effect of GA_3 and Sugar Treatment on Fresh Weight Reduction

Treatment	Fresh Weight Reduction (g/g)	
GA_3		
G_0	25,00	A
G_1	21,14	A
G_2	19,27	A
G_3	18,32	A
Sugar		
S_0	18,89	b
S_1	16,18	A
S_2	16,43	ab
S_3	32,23	C

Note : the numbers followed by the same letter in the same column are not significant according to Duncan's Multiple Range Test at the level of $\alpha = 0.05$.

The lowest fresh weight reduction occurred in treatment S1 with an average of 16.18 g and the highest reduction in fresh weight occurred in treatment S3 with an average of 32.23 g. Based on the research results, it shows that sugar treatment with high contrast results in a higher reduction in the fresh weight of cut tuberose flowers. The reduction in fresh weight of cut flowers is related to the total absorbed water solution (Table 14). The relationship between the two, based on research results, shows that the more water absorbed by cut tuberose flowers, the greater the reduction in fresh weight. The use of sucrose in the display solution affects water absorption, loss of water transpiration, maintaining better water relations (Battacharjee, 1998).

Number of Blooming Flowers

GA_3 and sugar treatments did not have an interaction effect on the number of blooming flowers. GA_3 and sugar treatments also did not have an independent effect on the number of blooming flowers (Table 3).

The flower blooming process is influenced by internal factors such as cell turgidity, and external factors such as temperature and humidity. Cell turgidity is influenced by the absorption of solutions into the cells by osmosis. Gibberellin stimulates the activity of hydrolytic enzymes, especially α-amylase which hydrolyzes starch into glucose compounds (Kumari et al., 2018). An increase in the amount of glucose can increase the amount of dissolved substances, thereby reducing the osmotic potential in cells and causing an increase in solution uptake. However, in this study GA_3 did not have a significant effect on the blooming of cut tuberose flowers. Previous research results also reported that GA_3 did not have a significant effect on the blooming of tuberose flowers (Hutchinson et al., 2004)

Table 3. Independent Effect of GA_3 and Sugar Treatment on Total Flowers Blooming

Treatment	/Total Flowers Blooming (%)	
GA_3		
G_0	65,82	A
G_1	63,73	A
G_2	65,40	A
G_3	63,90	A
Sugar		
S_0	61,76	A
S_1	70,90	A
S_2	68,30	A
S_3	57,89	A

.Note : the numbers followed by the same letter in the same column are not significant according to Duncan's Multiple Range Test at the level of α = 0.05.

Flower Withering Period

GA_3 and sugar treatments did not have an interaction effect on the wilting period of cut tuberose flowers. Independently, only the sugar treatment had a significant effect on the wilting period of tuberose flowers, while the GA_3 treatment did not (Table 4). The lowest flower wilting period was shown by treatment S0 with an average of 4.96 days, and the highest wilting period was shown by treatment S3 with an average of 6.96 days. Various physiological and biochemical studies state that the senescence process in flower corolla is

caused by lipid peroxidation, loss of cell membrane integrity, and protein degradation (Rani, 2014).

One cause of the acceleration of the senescence process is increased ethylene production in cut flowers. GA_3 can reduce ethylene production by suppressing ACC synthase activity (Sukasih, 2011). However, in this study GA_3 did not have a significant effect on the flower wilting period. The results of other studies also show that GA_3 independently does not have a significant effect on slowing down senescence in cut flowers of Matthiola incana L. (Ferrante et al., 2002) and in cut flowers of Narcissus tazetta (Sardoei, 2014).

Table 4. Independent Effect of GA_3 and Sugar Treatment on Flower Wilting Periode

Treatment	Flower Wilting Periode (hari/day)	
GA_3		
G_0	5,08	A
G_1	6,46	A
G_2	5,79	A
G_3	5,58	A
Gula/Sugar		
S_0	4,96	A
S_1	5,75	B
S_2	5,25	Ab
S_3	6,96	C

Note : the numbers followed by the same letter in the same column are not significant according to Duncan's Multiple Range Test at the level of $\alpha = 0.05$.

Total Water Absorbed

GA_3 and sugar treatment did not have an interaction effect on the total water absorbed. Independently, only the sugar treatment had a significant effect on the total absorbed water, while the GA_3 treatment did not (Table 5). Once separated from the main plant, cut tuberose flowers no longer receive the water supply they obtain from the soil through root absorption. This causes cut flowers to experience water stress. One of the mechanisms by which plants respond to water stress is by adjusting the degree of stomata opening to become narrower. Regulation of the degree of stomata opening will inhibit water loss through transpiration (Ai & Banyo, 2011)). The narrow degree of stomata

opening causes the absorption of GA_3 spray liquid to be less than optimal, so it does not have a real effect.

Table 5. Independent Effect of GA_3 and Sugar Treatment on Water Uptake

Treatment	Water Uptake (ml/ml)	
GA_3		
G_0	11,67	A
G_1	12,29	A
G_2	11,63	A
G_3	13,04	A
Gula/Sugar		
S_0	11,04	a
S_1	10,46	a
S_2	10,71	a
S_3	16,42	b

Note : the numbers followed by the same letter in the same column are not significant according to Duncan's Multiple Range Test at the level of $\alpha = 0.05$.

S3 treatment resulted in the highest total water absorbed with an average of 16.42 ml. This is because the sugar treatment on cut flowers affects the osmotic potential value in the cut flower cells. Osmotic potential is the chemical potential of water in a solution due to the presence of dissolved substances (Charvarria, 2012)). Osmotic potential is always negative because water moves from a point with a lower solute concentration (for example, pure water) to a point with a higher concentration. So, the higher the solute concentration at a point, the more negative the osmotic potential will be. The sugar pulsing treatment makes the osmotic potential of the cut tuberose flowers lower compared to the display water, thereby causing the display water to be absorbed into the cut tuberose flowers.

Freshness Period

GA_3 and sugar treatments did not have an interaction effect on the freshness of cut tuberose flowers. Independently, only the sugar treatment had a significant effect on the freshness of tuberose flowers, while the GA_3 treatment did not (Table 6).

Table 6. Independent Effect of GA_3 and Sugar Treatment on Vase Life

Treatment	Vase Life (hari/day)	
GA_3		
G_0	9,04	a
G_1	10,71	a
G_2	9,46	a

G_3	10,00	a
Gula/Sugar		
S_0	9,17	ab
S_1	9,71	b
S_2	9,08	a
S_3	11,25	c

Note : the numbers followed by the same letter in the same column are not significant according to Duncan's Multiple Range Test at the level of $\alpha = 0.05$

The lowest freshness period was shown by treatment S2 with an average of 9.08 days, while the highest freshness period was shown by treatment S3 with an average of 11.25 days. Sugar is generally used to extend the shelf life of cut flowers, this is related to increased water uptake and increased energy available from respiration (Arrom & Munne, 2012). The sugar pulsing treatment on cut tuberose flowers is useful as a supplier of exogenous carbohydrates. These carbohydrates will be used by plants to carry out the respiration process. In the respiration process, carbohydrates will be broken down into pyruvic acid through the glycolysis process which occurs in the cytoplasm, then the respiration process then moves to the mitochondria where the oxidative decarboxylation stage and the Kreb's cycle occur in the mitochondrial matrix and electron transport occurs in the inner mitochondrial membrane. The final product of respiration produced is energy in the form of ATP which is used by plants to carry out the anabolism process.

Previous research results reported that sugar treatment could increase the freshness of cut tuberose flowers (Kumari et al., 2018). Based on the results of observations in this study, it also shows that the wilting period of flowers (Table 4) has a close relationship with the freshness period of cut tuberose flowers (Table 6). The flower wilting period and flower freshness period show a linear relationship, where the longer the flower wilting period, the longer the freshness period, and vice versa.

CONCLUSION

Based on the research results, it is known that there is no interaction between GA_3 and sugar treatment in all observation components. Independently, the GA_3 treatment had no significant effect on all observation components, however, the sugar treatment had an effect on the observation components of fresh weight reduction, wilting period of flowers, total solution absorbed and flower freshness period. Based on the research results, it was found that the best effect was shown by the S3 treatment (sugar 75 g/l), with a wilting period of 6.96 days, a total solution absorbed of 16.42 ml and a freshness period of 11.25 days.

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