Effect of gibberellins on flowering of roses (*Rosa hybrida L.*)

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Abstract

Roses (*Rosa hybrida L.*) are prevalent ornamental flowers used as cut and sow flowers. This study aimed to examine the effect of gibberellins on the acceleration of flowering of roses planted in pots in Rahma Village, South Lubuklinggau I District, Lubuklinggau City, South Sumatra (-3°018'10", 102°054'41") with a height of 110.5 meters above sea level, from September to December 2021. The planting media consisted of Ultisol soil, cow dung, and rice husk (1:1) of 10 kg/pot. Gallica varieties of roses were sprayed with gibberellins (GA3) every 7 days until the plants were 98-day old. Harvesting was done when the flowers were in full bloom. The first harvest was from day 57 to day 116, a total of 17 harvests. The treatment of gibberellin concentration was tested at 6 levels, namely 0 ppm (Z0), 50 ppm (Z1), 100 ppm (Z2), 150 ppm (Z3), 200 ppm (Z4), and 250 ppm (Z5), with 4 groups, each consisting of 3 pots. From the study results, it was concluded that the administration of gibberellins (GA3) with concentrations between 50 ppm to 200 ppm accelerated flowering time between 2.88 to 10.5 days. Z3 increased the number of flowers by 32.5 buds, and Z2 produced flowers with the largest diameter of 7.16 cm. The length of the stalk and the number of petals on roses did not increase by gibberellin treatments. For the flowering of roses, it is recommended to administer gibberellin with a concentration of 150 ppm (Z3).

Keywords: flowering, Gallica, hormone, ornament, rose

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Introduction

A flower widely cultivated in tropical regions, such as Indonesia, is rose. Roses (*Rosa hybrida L.*) are prevalent ornamental flower plants used as cut and sow flowers. Roses are often used to beautify both traditional and modern gardens (Denysko et al., 2019). The rose types commonly cultivated in Indonesia are wild roses, ancient roses, and modern roses (Resti, 2021). The quality of roses is determined by stem length, aroma, size, and flower color (Horibe and Yamada, 2017). People prefer roses with a large flower, fragrant, and bright colors (Soundararajan et al., 2017; Waliczek et al., 2018).

A Rose plant is a shrub with dense flowers and various aromas depending on the variety (Rovna and Cerna, 2018). Gibberellins influence the growth of roses. Shinta et al. (2020) stated that giving gibberellins with a concentration of 400 ppm in rose plants affects the length and number of branches and flower strands. Gibberellins in plants play a role in stimulating germination and controlling active plant growth. Physiologically, gibberellins are able to encourage the growth of

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stem length and increase the size of flowers and leaves (Salmah, 2018).

Ghehsareh et al. (Ghasemi Ghehsareh et al., 2020) stated that a good medium for growing roses is a mixture of organic material and soil with a ratio of 1:1. Fertilizer application can increase stem length by more than 70 cm (Franco-Hermida et al., 2020). The blooming of rose buds is closely related to air temperature (Monder, 2021). The stages of development of roses consist of shoot apical development, flower meristems, and flower buds. Hormones are needed at shoot apical cell division and flower meristems stages (Hong et al., 2021).

One type of growth-regulating hormone is Gibberellic Acid (GA3). Gibberellins are complex natural biomolecules, originally found in the fungus *Gibberella fujikuroi* which plays a major role in plant physiology (Salazar-Cerezo et al., 2018). Commercially available, this hormone was discovered more than 100 years ago and were shown to play roles in growth, seed maturation, germination, root initiation and elongation, hypocotyl, and flowering (Pujiasmanto, 2020). Gibberellins affect uptake and respond to nitrogen supply and improve leaves and young shoots thus playing a role in the growth and development of plant organs (Hedden, 2020). The specific role of gibberellins in roses is supporting their adaptation to water shortages in the soil for a long time (Gadzinowska et al., 2020). Gibberellins are synthetic hormones that help turn shoots into flowers and trigger plant stem elongation (Yamaguchi and Kamiya, 2000). Gibberellin can be applied as a growth stimulant by immersion or spraying. Therefore, it is necessary to study the role of gibberellin and its effect on the flowering of roses.

Materials and Methods

The research was carried out in Rahma Village, South Lubuklinggau I District, Lubuklinggau City, South Sumatra (-3°018’10”, 102°054’41”) with an altitude of 110.5 meters above sea level, from September to December 2021. This study used an experimental method with randomized block design. The treatment with gibberellin concentration was assayed at 6 levels, namely: 0 ppm (Z0), 50 ppm (Z1), 100 ppm (Z2), 150 ppm (Z3), 200 ppm (Z4), and 250 ppm (Z5), which were divided into 4 groups, each consisting of 3 pots planted with one plant material; therefore, there were 72 pots in total. Planting media used in this research included Ultisol soil, cow dung, and rice husks with a ratio (1:1) of 10 kg/pot. The rose plants, Gallica variety, were used in the study, which were 35 days old, 25 cm high, and 1 cm diameter stems. Gibberellins (GA3) were sprayed every 7 days until the plants were 98 day-old.

Flowers were harvested in full bloom in the morning by cutting the flower stalks using scissors. The first harvest was done on day 57, and the last was on day 116, with 17 harvests in total. Parameters observed included flowering time, number of flowers, flower stalk length, flower diameter, and number of petals. The research data were processed using Analysis of Variance, with SAS software Version 9.4, and tested with Honest Significant Difference Test at 1% test level and regression analysis.

Results

Results of the analysis of variance showed that gibberellin had a very significant effect on all observed variables, except for the length of the flower stalk and the number of petals (Table 1).

Table 1
Effects of gibberellin concentration on flowering of roses.

Parameter	Gibberellin Concentration						1%
	Z0 (0 ppm)	Z1 (50 ppm)	Z2 (100 ppm)	Z3 (150 ppm)	Z4 (200 ppm)	Z5 (250 ppm)	
Flowering Time (day after planting)	48,38 B	42,38 AB	38,75 A	38,13 A	37,88 A	45,50 AB	7,76
Number of Flowers (buds)	13,00 A	22,00 ABC	25,75 BC	32,50 C	24,00 ABC	17,75 AB	12,22
Flower stalk length (cm)	8,83	8,96	9,06	8,94	8,87	8,84	-
Flower Diameter (cm)	6,82 A	6,94 AB	7,16 B	7,08 AB	6,97 AB	6,85 A	0,28
Number of petals (strand)	20,18	20,37	21,13	21,08	20,98	20,93	-

The numbers followed by the same letter in the row mean that they are not significantly different (P≤0.01).

The concentration of gibberellins significantly influenced the flowering time of roses. In fact, Z2 was significantly different from Z0 while between Z1 to Z5, and between Z0, Z1, and Z5 no significant differences were found (Table 1). The fastest time of the first flowering occurred in Z4, i.e., 37.88 days while the longest time of flowering occurred in Z0, i.e., 48.38 days (Fig. I). Giving gibberellins with concentrations of Z1 to Z5 accelerated the average flowering time between 2.88 to 10.5 days.

Administering gibberellins significantly affects the number of flowers. The treatment of Z3 was significantly different from Z0 and Z5 while not showing a significant difference from Z1, Z2, and Z4 (Table 1). The highest number of flowers was found in treatment Z3, i.e., 32.50 buds while the least number of flowers was found in treatment Z0, i.e., an average of 13.00 buds (Fig. II). The number of flowers produced by giving gibberellins increased on average between 4.75 buds to 19.5 buds per plant. Furthermore, the analysis of variance showed that the concentration of gibberellins had no significant effect on flower stalk length (Table 1). The longest flower stalk was found at Z2, i.e., 9.06 while the shortest was at Z0, i.e., 8.83 cm (Fig. III). The increase in flower stalk length was relatively small under gibberellin treatments, on average, between 0.01 cm to 0.23 cm.

The concentration of gibberellins had a very significant effect on flower diameters. The treatment of Z2 was significantly different from Z0 and Z5 while not significantly different from Z1, Z3, and Z4 (Table 1). The flower with the largest diameter was found at Z2, i.e., 7.16 cm; the smallest flower was at Z0, i.e., 6.82 cm (Fig. IV). The roses administered with gibberellins were larger than those without gibberellins. The increase in flower diameters under gibberellin treatments were between 0.03 cm to 0.35 cm. The treatment of gibberellin concentration had no significant effect on the number of flower petals (Table 1).

Discussion

The concentration of gibberellins showed a significant effect on flowering time, number of flowers, and flower diameter, but no significant

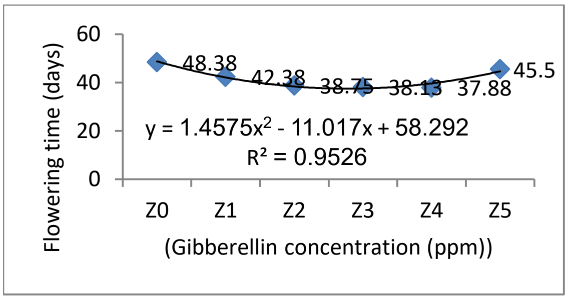

Fig. I. Effects of gibberellins on flowering time

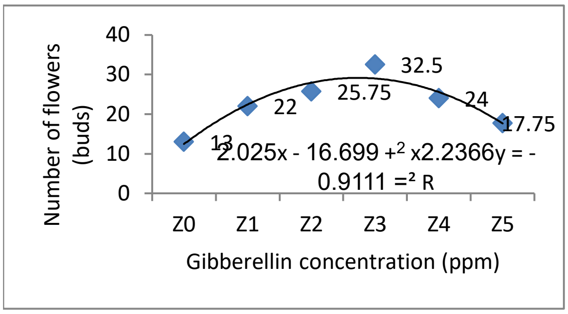

Fig. II. Effects of gibberellins on the number of flowers

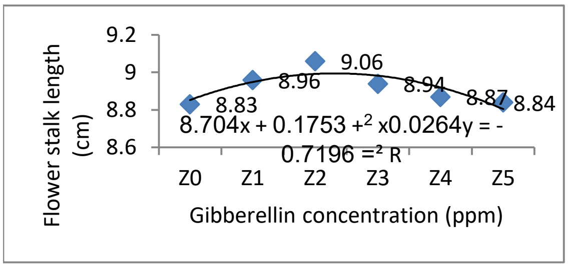

Fig. III. Effects of gibberellins on flower stalk length

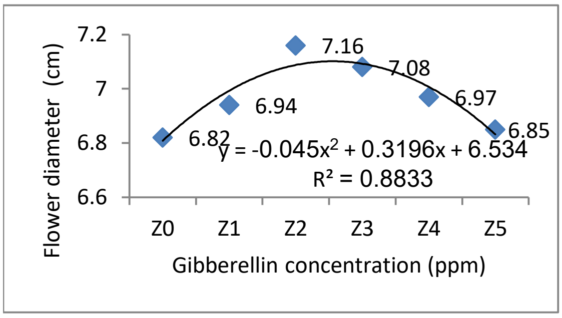

Fig. IV. Effects of gibberellins on flower diameter

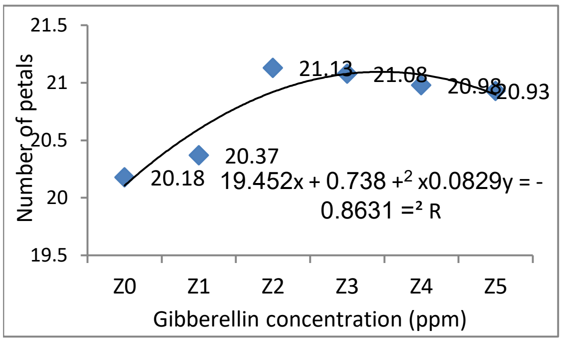

Fig. V. Effects of gibberellins on the number of petals effect was found on flower stalk length and number of rose petals. Gibberellins affect flowering time and number and diameter of flowers. Flower initiation and accelerating flowering by gibberellins occurred as a result of stimulation of cell division and enlargement so as to stimulate flower formation (Koo et al., 2018) . Gibberellins are tetracyclic diterpenoid phytohormones that affect various aspects of plant development including regulation of flower, fruit, and seed development (Gao and Chu, 2020). Gibberellins are organic compounds that are not classified as nutrients but play a role in cell division and stem growth and elongation as well as stimulation of the flowering phase.

The concentration of 200 ppm (Z4) was able to stimulate the release of the first flowers faster. Still, the results were not significantly different with the administration of gibberellins as much as 100 ppm (Z2) and 150 ppm (Z3). Application of gibberellins in the early stages of flowering increased the morphological differences of the resulting flowers (Santosa et al., 2018). The treatment with gibberellins was reported to affect leaf sugar and starch contents, thereby helping to increase carbohydrate reserves in shoots that can stimulate flowering (Kuryata and Shataliuk, 2019). Gibberellins are a growth-stimulating hormone that can affect flowering and accelerate dormancy through enzymatic stimulation (Niharika et al., 2021). Low concentration of gibberellins was found to result in slow flower formation, but excessive application of gibberellin inhibited the formation of primordial flowers (Li et al., 2018).

Gibberellin plays a major role in regulating various physiological processes in plant tissue (Sharma and Zheng, 2019). Niharika et al. (2021) explained that gibberellins have a very important role in increasing plant growth and development and also its adaptation to environmental conditions. The effect of gibberellins on the elongation of upper plant cells can occur maximally at lower hormone concentrations (Ramon et al., 2020). The difference in the level of gibberellins affects the mechanism of regulating flowering properties in rose plants (Yi et al., 2021). Gibberellins also affect flower longevity and flowering arrangements (Kumar et al., 2021).

Application of gibberellins on rose plants did not affect the length of the stalk and the number of petals. The morphology of the rose stalk is an important characteristic. The development of flower stalk length is not only influenced by gibberellins, but auxins and cytokinin also play a larger role through regulating cell division and development (Jing et al., 2020).

Conclusion

The use of gibberellins (GA3) with concentrations between 50 ppm to 200 ppm accelerated flowering time between 2.88 to 10.5 days. Gibberellin 150 ppm (Z3) increased the number of flowers by 32.5 buds. Gibberellins administered at a concentration of 100 ppm (Z2) produced flowers with the largest diameter of 7.156 cm. For the flowering of roses, it is recommended to treat the plants with gibberellin at a concentration of 150 ppm (Z3).

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