Application of Gibberellins in Melon Cultivation Based on Substrate Hydroponic System with Drip Fertigation

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ABSTRACT

Gibberellins are a group of plant hormones that play a role in regulating plant growth and development. This study aimed to determine the timing and concentration of gibberellin administration that is most effective in stimulating melon plants’ vegetative and generative growth in a substrate hydroponic system using the drip fertigation method. This research was carried out from May to August 2023 in Kragilan Surakarta. This study was conducted using a one-factor Complete Randomized Design (RAL) that has seven levels based on the method of gibberellin application, namely Level 1: G0 without Gibberellin (Control). Level 2: G1 Gibberellin concentration 60 ppm sprayed on days 5, 10, and 15 hst. Level 3: G2 Gibberellin concentration 60 ppm sprayed on day 20,25,30 hst. Level 4: G3 Gibberellin concentration 80 ppm sprayed on day 20,25,30 hst. Level 5: G4 Gibberellin concentration 80 ppm sprayed on day 30,35,40 hst. Level 6: G5 Gibberellin concentration 100 ppm sprayed on day 30,35,40 hst. Level 7: G6 Gibberellin concentration 100 ppm sprayed on day 30,40,50 hst. The results showed that application of gibberellins with concentrations of 100 ppm at 30,40 and 50 days after planting (HST) resulted in significant differences in chlorophyll content of a+b (total) compared to applications of concentrations of 60 ppm, 80 ppm, and 100 ppm at different times. There was a significant difference in sweetness compared to applying GA3 at concentrations of 100 ppm at different times. The application of GA3 did not significantly affect chlorophyll a, chlorophyll b, fruit diameter, fruit weight, root weight, and crush weight in melon plants based on Hydroponic systems using drip fertigation.

KEYWORDS

Gibberellin, Melon Cultivation, Hydroponic Substrate, Drip Fertigation.

ARTICLE INFORMATION

ACCEPTED: 01 January 2024 PUBLISHED: 14 January 2024 DOI: 10.32996/jeas.2024.5.1.1

1. Introduction

Melon (Cucumis melo L.) belongs to the Cucurbitaceae family and is a very popular fruit in Indonesia (Harjadi, 2009; Sesanti et al., 2018; Simanungkalit et al., 2013). This fruit is known for its sweet and fresh taste and its nutritional content, including protein, vitamin C, and magnesium. According to data from the Central Statistics Agency, this advantage has pushed melon production in Indonesia to be significant, reaching 118,711 tons in 2022 (Fatonah et al., 2009; Sobir & Siregar, 2010; Statistik, 2021). Nevertheless, there was a decrease in production by 8.08% in the year compared to the previous year, continuing the correction trend since 2021.

Gibberellins are crucial in regulating plant growth and development as a group of plant hormones. This hormone involves various physiological processes, including cell elongation, breakdown of seed dormancy, flowering, fertilization, growth of shoots and branches, and influence on carbohydrate metabolism (Marhaeni et al., 2018; Soedarya, 2010). Previous studies, such as those conducted by Harjadi (2009), showed that using gibberellins can positively impact flower age, number of flowers, and flower formation in melon plants.

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Recent research, such as that conducted by Cokrosudibyo (2022), shows that GA3 (gibberellic acid) can significantly increase plant height, bulb weight, dry weight per plant, and weight per plot in shallots. In addition, the results of research by Kalsum Ummu (2021) highlighted that spraying GA3 at 1 and 3 weeks after anaesthesia can reduce the amount of hair loss in citrus fruits (Christy, 2020; Fikriyah & Sitawati, 2018; Maharani et al., 2018). These findings are important to understanding how to effectively use gibberellins in managing crop production, particularly in citrus fruits.

Therefore, this study aims to explore the application of gibberellins in melon cultivation based on substrate hydroponic systems by drip fertigation method. Hydroponics, or “soilless gardening,” offers the advantages of efficient water use, optimal nutrient control, unnecessary soil, increased production, and better pest and disease control (Buditjahjono, 2007; Makhliza et al., 2014; Nora et al., 2020).

This research will focus on determining the most effective time and optimal concentration of gibberellin administration to stimulate melon plants’ vegetative and generative growth in the context of hydroponics. The results of this study are expected to significantly contribute to developing more efficient and sustainable agricultural practices in the future.

2. Materials and Methods
This research was conducted from May to August 2023 in Kragilan Surakarta. The laboratory research will be conducted at the Laboratory of the Faculty of Agriculture, Sebelas Maret University, Surakarta, in August 2023.

The tools used in this study include meters, rulers, scales, digital cameras, ajir, raffia rope, sprayers, polybags, measuring cups, pH meters, thermometers, scissors, fertigation system hydroponic installations, and TDS meters. The materials used in this study include melon seeds, cocopeat growing media, AB mix nutrients, and gibberellins (GA3).

This study was conducted using a one-factor Complete Randomized Design (RAL) that has seven levels based on the method of application of gibberellins, namely (Jazuli et al., 2021; Pertiwi et al., 2014):

- G0 Without Gibberellins (Control)
- G1 Gibberellin concentration 60 ppm sprayed on day 5,10,15 hst
- G2 Gibberellin concentration 60 ppm sprayed on day 20,25,30 hst
- G3 Gibberellin concentration 80 ppm sprayed on day 20,25,30 hst
- G4 Gibberellin concentration 80 ppm sprayed on day 30,35,40 hst
- G5 Gibberellin concentration 100 ppm sprayed on day 30,35,40 hst
- G6 Gibberellin concentration 100 ppm sprayed on day 30,40,50 hst

The seven levels were repeated 4 times, resulting in 28 experimental units.

The observational data will be analyzed using ANOVA for treatments that show a significant difference in response based on the F test at a significance level of 5%. DMRT test was performed at a 5% significance level. The implementation of the first research stage is the manufacture of Green House. The media used is cocopeat, placed in polybags measuring 35 x 35 cm with a planting distance of 40 x 40 cm.

AB Mix used as follows: N of 215 ppm, P of 86 ppm, K by 175 ppm, S by 114.02 ppm, Mg of 85 ppm and micro hara element with composition as follows: Mo by 0.122 ppm, Zn by 0.805 ppm, Bo by 0.488 ppm, Mn by 0.732 ppm, Cu by 0.78 ppm, and Fe by 6.8 ppm.

Making a stock solution of AB Mix as much as 100 litres, the following materials are used: Solution A: Potassium Nitrate: 12 kg, Fe (EDTA): 1 kg, Calcium Nitrate: 20 kg. Solution B: Magnesium Sulfate: 17 kg, Sodium Molybdate: 2 grams, Zinc Sulfate: 15 grams, Manganese Sulfate: 121 grams, Monobasic Potassium: 7 kg, Copper Nitrate: 183 grams, Sodium Borate: 123 grams. The water used to dissolve AB Mix fertilizer materials is RO water with pH 6, TDS 56 ppm, and EC 0.09. Once the stock solution is formed, its pH is 4.6, TDS is 8638 ppm, and EC is 17.540. Fertilizing application on plants is carried out at a ratio of 1:200. The seedbed is planted for 14 days and then transplanted into polybags. Each polybag is filled with 2 plants. Nutrient feeding to plants is carried out with TDS concentrations of around 1400-1600 ppm and EC between 29-32. At 1-5 days after planting (hst), watering is carried out 1 time a day with 500 ml per polybag. At the age of 6-10 hst, watering is carried out 2 times a day in 1000 ml per polybag. From the age of 11 until harvest, watering is carried out 3 times daily in 1500 ml per polybag. The irrigation system used is a drip irrigation system. For the propagation of already tall plants, wire is used as a support (Furoidah, 2018; INDRAWAN et al., 2021). Plants that have grown tall are tied using raffia rope to the wire provided as a support. The application of GA3 hormone is done by spraying all parts of melon plants according to treatment. Maintenance includes diving, handling pests (Plant Disturbing Organisms) such
as diseases, pests, and weeds), binding plant stems to the landscape, pruning, fruit selection, and fruit thinning. Harvesting: cutting the fruit stalk with a distance of at least 3 cm from the base of the fruit to avoid biological damage due to microorganisms at 70 days after transplanting. Modifier observations include Chlorophyll content, header dry weight, root dry weight, fruit weight per plant (g), Fruit diameter, Fruit sweetness (brix), and Header/root ratio.

3. Results and Discussion
In diagram 1, GA3 with concentrations of 100 ppm applied at 30, 40, and 50 HST showed significant differences in chlorophyll content of a+b (total) when compared to GA3 applications with concentrations of 60 ppm, 80 ppm, and 100 ppm at different times. Table 1 In the control, chlorophyll content a+b (total) showed no significant difference compared to chlorophyll content a+b (total) in GA3 treatment with concentrations of 60 ppm, 80 ppm, and 100 ppm at different times.

Diagram 2 shows that the use of GA3 with 60 ppm concentrations applied at 20, 25, and 30 HST did not produce a significant difference in fruit diameter compared to fruit diameter in GA3 treatment with concentrations of 60 ppm, 80 ppm, and 100 ppm applied at different times. The same applies to GA3 applications with concentrations of 80 ppm at 20, 25, and 30. HST did not produce significant differences in fruit diameter compared to fruit diameter in GA3 treatments with concentrations of 60 ppm, 80 ppm, and 100 ppm applied at different times. Likewise, applying GA3 with concentrations of 60 ppm at 5, 10, and 15 HST did not produce significant differences in fruit diameter compared to fruit diameter in GA3 treatments with concentrations of 60 ppm, 80 ppm, and 100 ppm applied at different times.

In addition, applying GA3 with concentrations of 100 ppm at 30, 40, and 50 HST did not produce significant differences in fruit diameter compared to fruit diameter in GA3 treatments with concentrations of 60 ppm, 80 ppm, and 100 ppm applied at different times. Similarly, applying GA3 with concentrations of 80 ppm at 30, 35, and 40 HST did not produce significant differences in fruit diameter compared to fruit diameter in GA3 treatments with concentrations of 60 ppm, 80 ppm, and 100 ppm applied at different times.

In control, the diameter of the fruit also did not show a significant difference compared to the diameter of the fruit in GA3 with concentrations of 60 ppm, 80 ppm, and 100 ppm applied at different times.

![Figure 1. Chlorophyll a+b diagram](image1)

![Figure 2. Fruit Diameter Diagram](image2)
In diagram 3, GA3 with concentrations of 80 ppm applied at 20, 25, and 30 HST showed no significant difference in sweetness levels compared to GA3 applications of 60 ppm at different times and 80 ppm at 30, 35, 40 HST. However, there is a significant difference in sweetness levels when applying GA3 concentrations of 100 ppm at different times. In control, the sweetness level significantly differed from that in the GA3 treatment concentrations of 60 ppm, 80 ppm, and 100 ppm with different time applications.

**Figure 3. Diagram Brix**

In diagram 4, there was no significant difference in root weight when using GA3 concentrations of 60 ppm, 80 ppm and 100 ppm with application at different times. The response of plants to root weight in the control also showed no significant difference.

**Figure 4. Root Weight Diagram**

In diagram 5, there is no significant difference in header weight when using GA3 with concentrations of 60 ppm, 80 ppm and 100 ppm applied at different times. Similarly, the response of plants to the control also showed no noticeable difference in header weight.

**Figure 5. Header Weight Chart**
4. Conclusion
Applications of GA3 with concentrations of 100 ppm applied at 30, 40, and 50 HST showed significant differences in chlorophyll content of a+b (total). There was a significant difference in sweetness levels compared to GA3 applications of 100 ppm concentrations at different times. The application of GA3 did not significantly affect chlorophyll a, chlorophyll b, fruit diameter, fruit weight, root weight and weight in melon-based subtract hydroponic systems with drip fertigation.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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