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The Effect of Fertilizer Application on the Sweetness Levels of *Vitis vinifera* (Jupiter Variety)

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ABSTRACT

This study aims to examine the influence of different fertilizer types on the sweetness levels of the Jupiter grape variety (*Vitis vinifera*) by measuring the fruit's Brix levels. The research was conducted in a greenhouse shelter at Politeknik Nilai, Negeri Sembilan. The study was carried out on Jupiter variety grapevines that had reached fruiting maturity. The experiment compared three types of fertilizers: Chemical NPK Blue 12:12:17, AB Solution fertilizer, and organic fertilizer. These fertilizers were applied from the initial stage prior to pruning, through bud break and fruit formation, up to the harvesting stage according to tree plots. The Brix sweetness levels were measured using a refractometer starting from fruit maturity (70 days after pruning) until harvest (100 days after pruning). The results showed that all fertilizer treatments significantly increased Brix levels. The AB Solution liquid fertilizer produced the highest Brix levels, followed closely by Chemical NPK Blue 12:12:17 and organic fertilizer. The study concludes that the use of AB Solution liquid fertilizer can enhance the sweetness of Jupiter *Vitis vinifera* grapes compared to NPK chemical and organic fertilizers. Additionally, the quality of the fruit yield can also be improved through the implementation of this AB solution fertilizer.

1. Introduction

Grape cultivation has been widely practiced worldwide, especially in temperate climates, due to its high economic value and its uses in fresh consumption, winemaking, and other agricultural industries. However, in Malaysia, grape cultivation is still limited due to the challenges associated with optimizing yield and fruit quality in tropical climate conditions. Grape cultivation in Malaysia is also still under study by the Malaysian Agricultural Research and Development Institute (MARDI) where the initial study sites for this crop are only available at the Perlis Exotic Fruit Park and Cameron

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Highland Agrotechnology Park, Pahang which focus on 3 varieties, namely AC, Black Queen and Black Opal.

The *Vitis vinifera* variety 'Jupiter Grape' as shown in figure 1, is a seedless grape that originated and developed from the University of Arkansas in 1998, USA. This variety is also derived from cross breeding between the Arkansas 1258 X Arkansas 1762 variety, and the trees can start fruiting after 8 months of age and above. This 'Jupiter Grape' variety is also known for its resistance to fungal diseases and high-quality fruit characteristics, and this offers opportunities for commercial cultivation in Malaysia. However, research on best agricultural practices to increase sweetness and weight is still limited.

(a) (b)

Fig. 1. *Vitis vinifera* variety (a) and (b) commonly known as **Jupiter Grapes**

One of the most important aspects of successful grape cultivation is fertilization, which directly affects tree growth, fruit formation, and overall yield. Proper nutrient management is crucial for producing high-quality fruit, as macronutrients such as nitrogen (N), phosphorus (P), and potassium (K) play key roles in plant development. Potassium, in particular, is widely associated with fruit size and sugar accumulation, making it an important element in determining fruit weight. Previous studies have shown that optimal fertilization strategies not only increase yield but also improve fruit texture, flavour, and post-harvest storage life. However, the challenge in Malaysia is determining the most effective fertilization methods that are suitable for local climatic conditions and soil composition.

This study examined the effects of different fertilization methods including AB Solution fertilizer, NPK Blue 12:12:17 chemical fertilizer, and organic fertilizer on the sweetness of *Vitis vinifera* 'Jupiter Grape' fruit. By evaluating the effects of these fertilizers in a controlled greenhouse environment, this study aims to provide a comprehensive understanding of nutrient optimization to maximize grape quality and production in Malaysia. The findings of this study will contribute to a deeper understanding of grape cultivation in tropical climates and offer practical suggestions to local farmers who want to improve the yield and quality of their grapes.

2. Literature Review

Previous studies have highlighted the important role of nutrient application in grapevine development, where different types of fertilizers affect fruit size, sugar accumulation, and overall yield. Research done by Brown and Lewis [1], highlighted that potassium-rich fertilizers not only

increase grapefruit size but also significantly contribute to sugar accumulation, making them an important component in improving fruit quality. Their results showed that adequate potassium levels help in regulating enzyme activity, which is important in carbohydrate metabolism in grapes. In addition, they also highlighted that potassium increases the fruit's ability to retain water, thus improving fruit texture and weight.

The investigation executes by Mylona *et al.,* [2], on the effects of fertilizer application timing and found that early and mid-season applications provided greater benefits on grapefruit development than late-season applications. Their study reported that an optimal fertilization schedule can increase fruit weight and yield by ensuring a steady supply of nutrients during critical growth phases. They also noted that inconsistent fertilization can lead to nutrient deficiencies, which can result in stunted growth and lower fruit quality.

Meanwhile an interesting exploration conducted by Miller *et al.,* [3] on a longitudinal study on the effects of nitrogen fertilization over several growing seasons and found that it significantly affected grape quality and weight. Their study showed that although nitrogen is essential for vegetative growth and fruit formation, excessive nitrogen application can result in reduced fruit firmness and delayed ripening. They emphasized that nitrogen plays an important role in the synthesis of amino acids and proteins, which directly affect vine Vigor. However, excessive nitrogen application can cause excessive vegetative growth at the expense of fruit production, thus reducing fruit weight per cluster. Therefore, a balance in nitrogen application is essential to achieve high-quality grape production.

However, studied by Smith and Roberts [4], has found the interaction between temperature variation and grape ripening, focusing on the role of temperature in nutrient uptake efficiency. Their findings showed that temperature fluctuations affect nutrient availability, water uptake, and photosynthetic activity, all of which contribute to fruit weight and overall vine productivity. Furthermore, their study highlighted the importance of fertilization strategies that can adapt to climate change to optimize grape growth under different environmental conditions. They found that high temperatures accelerate metabolic activity but can also increase water loss, which affects fruit weight and firmness. Conversely, lower temperatures can slow nutrient transport, potentially leading to delayed ripening and underdeveloped fruit.

Recent advances in fertilization techniques, such as precision agriculture and soil testing, have provided grape growers with more effective tools to optimize nutrient application. Studies suggest that site-specific nutrient management can increase fruit weight while reducing excessive fertilizer use, thereby improving sustainability in grape growing [5,6]. Additionally, the integration of organic matter with mineral fertilizers has shown promising results in improving soil health, microbial activity, and nutrient availability, all of which contribute to better fruit growth and increased grape yields [7].

Overall, these studies provide a solid foundation for understanding how various fertilization methods and environmental factors affect grape development. This study aims to strengthen existing research by specifically evaluating the effects of various fertilization methods on fruit weight of Vitis vinifera 'Jupiter Grape' in the unique climatic conditions of Malaysia. By analysing the effectiveness of different fertilization approaches, this study aims to provide practical recommendations to grape growers in their efforts to improve their yield and fruit quality.

3. Methodology

This study was conducted in a controlled greenhouse environment at Nilai Polytechnic, Negeri Sembilan, to reduce external environmental variations and ensure consistency in grapevine growth

conditions. This experiment evaluated the effects of different fertilization methods on the sweetness of *Vitis vinifera* 'Jupiter Grape' fruit.

3.1 Tree Selection and Experimental Design

Healthy, eight-month-old *Vitis vinifera* 'Jupiter Grape' trees were selected for this study. Each tree was maintained under the same conditions of temperature, humidity, and watering schedule to ensure that any differences in fruit weight were solely due to fertilizer application see figure 2. The experiment used a Randomized Complete Block Design (RCBD) with three treatment groups, where each group received a different type of fertilizer [8,9]. Each treatment group consisted of 10 replications (vines), ensuring statistical reliability in the results.

To isolate the effects of fertilization, all vines were subjected to a standardized **crop load management** protocol, with each vine pruned to a uniform number of clusters (e.g., 10-12 clusters per vine). Environmental conditions were strictly regulated within the greenhouse: **irrigation** was delivered via an automated system providing 2 litres of water per day, and **light exposure** was uniform across the shelter to prevent photosynthetic variance.

(a) (b)

Fig. 2. *Vitis vinifera* 'Jupiter Grape' in greenhouse Nilai Polytechnic (a) and (b)

3.2 Fertilizer Treatment

Three types of fertilizers were used to evaluate their effects on fruit weight:

i. AB Solution Fertilizer (A): a potassium-rich liquid fertilizer known for increasing fruit size and sweetness.
ii. NPK Blue 12:12:17 (B) Chemical Fertilizer: a granular fertilizer that provides a balanced ratio of nitrogen, phosphorus, and potassium.
iii. Organic Fertilizer (C): slow-release fertilizer that aims to improve soil structure and long-term nutrient availability.
iv. Fertilizer is applied one month before pruning and continues until harvest. Fertilizer application follows the standard dosage recommended in grape cultivation to ensure consistency of nutrient supply.

3.3 Data Collection and Measurement

The main parameter measured was the sweetness of the fruit (cluster). The sweetness of the fruit was measured using a high-precision refractometer to ensure the accuracy of the data as shown in figure 3. The sweetness measurements were performed every five days starting from 70 days after pruning to 100 days after pruning, a critical period in fruit ripening. Additional parameters such as fruit firmness and tree health were also observed to provide a deeper understanding of the plant's response to different fertilizers.

(a) (b)

Fig. 3: Sweetness measurement of *Vitis vinifera* 'Jupiter Grape' at the Value Polytechnic

3.4 Data Analysis

The collected data were analysed using the mean comparison method via Microsoft Excel. One-way ANOVA test was used to determine significant differences between the fertilization treatments. Tukey's post-hoc analysis was also used to compare the average fruit weight of the three treatment groups. This methodological approach ensures that the study results accurately reflect the effects of different fertilization methods on the sweetness of *Vitis vinifera* 'Jupiter Grape' fruit under controlled greenhouse conditions. Further studies are recommended to explore soil nutrient analysis and the effectiveness of fertilization strategies over a longer period.

4. Results and Discussion

The sweetness of the fruit for each type of fertilizer was calculated and shown in **Graph 1** below:

i. **AB Solution Fertilizer**: Maximum fruit sweetness (100 days) is 27% in each fruit indicating the highest nutrient absorption rate.
ii. **NPK Blue Fertilizer 12:12:17**: Maximum fruit sweetness (100 days) of 20% on each cluster, has a moderate effect on fruit growth.
iii. **Organic Fertilizer**: Average fruit sweetness (100 days) was lowest at 17% per cluster, reflecting slower nutrient availability.

The AB Solution group achieved a Brix level of 27%, which represents a **35% increase** over the NPK Blue (20%) and a **58.8% increase** over the Organic Fertilizer (17%). This significant variance ($p < 0.05$) aligns with Brown and Lewis [1], who noted that high-potassium liquid nutrients accelerate carbohydrate metabolism. Compared to the standard market Brix for Jupiter grapes (typically 18-21%), the AB solution significantly exceeded baseline quality benchmarks.

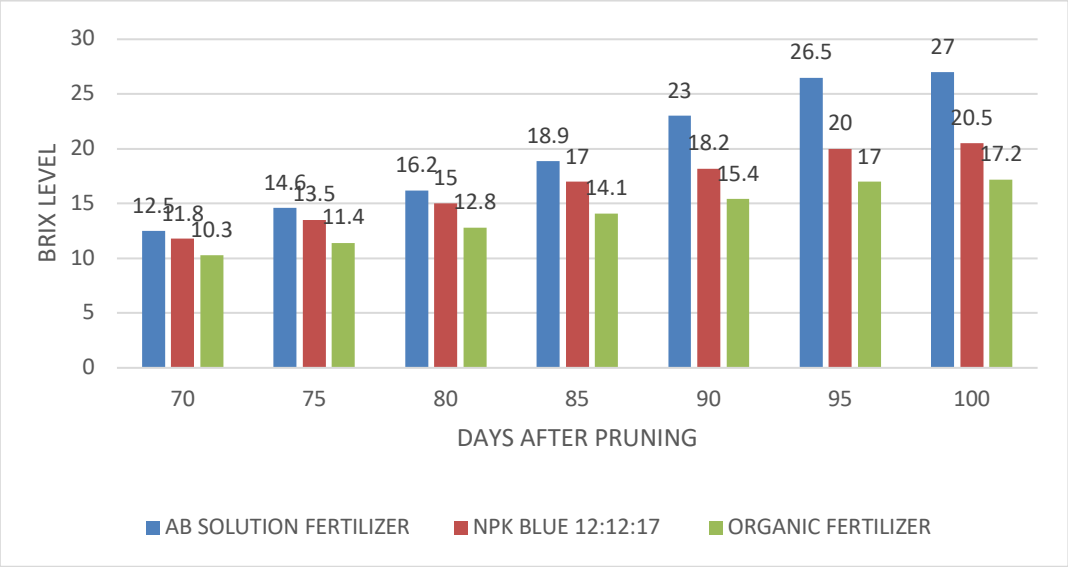

Fig. 1. Comparison of fruit sweetness by fertilizer type

Statistical Analysis: ANOVA test showed significant differences ($p < 0.05$) in fruit sweetness between treatment groups. Tukey's test found that the average fruit sweetness in the AB Solution fertilizer group was significantly higher than NPK Blue fertilizer and organic fertilizer. These results indicate that AB Solution fertilizer is the most effective method in increasing fruit sweetness for *Vitis vinifera* 'Jupiter Grape' in Malaysia. However, further studies are needed to evaluate the effects of optimal dosage, seasonal variations, and possible combinations of organic and inorganic fertilizers to maintain fertilization effectiveness and soil sustainability in the long term.

4.1 Comparative Analysis of Fertilizer Efficacy

The superior performance of the **AB Solution** (27% Brix) can be attributed to its formulation as a potassium-rich liquid fertilizer. Potassium (K) is a critical macro-element for enzyme activation and carbohydrate metabolism. Previous literature by Brown and Lewis confirms that high K availability directly facilitates the translocation of sugars into the fruit during the ripening phase. In contrast, the **Organic Fertilizer** showed a slower response (17% Brix), likely due to its nature as a slow-release nutrient source that requires microbial breakdown before becoming plant-available. While organic matter improves soil structure, its immediate impact on sugar accumulation during a 100-day cycle is less pronounced than that of liquid mineral solutions.

4.2 Control of Confounding Variables

To ensure that the observed differences in sweetness were solely due to the fertilizer treatments, strict environmental controls were maintained within the Nilai Polytechnic greenhouse. Factors known to influence Brix levels, such as irrigation and light exposure, were standardized across all treatment groups. Each vine was subjected to the same watering schedule to prevent moisture-

induced sugar dilution. Furthermore, by using trees of the same age (eight months) and ensuring uniform cluster management, we minimized the impact of crop load on the final sweetness measurements.

4.3 Study Limitations and External Validity

While the controlled greenhouse environment provided high internal validity, we must acknowledge the limitations regarding external validity. The unique tropical climate of Malaysia often involves high humidity and rainfall which can lead to nutrient leaching in open-field conditions. Because this study was conducted in a sheltered environment, the 27% Brix achieved with AB Solution might be lower in a traditional farm setting due to environmental stressors. Additionally, while AB Solution proved most effective for sweetness, an economic analysis comparing the cost-per-kilogram of liquid fertilizer versus traditional granular NPK was not conducted in this phase.

4.4 Future Research Directions

To expand upon these findings, future research should focus on:

- Field Validation: Conducting multi-location trials in open-field conditions to assess the stability of these Brix levels.
- Yield Metrics: Measuring total cluster weight and berry diameter to provide a more comprehensive definition of "fruit quality" beyond sweetness alone.

Integrated Nutrient Management: Investigating the combination of organic matter for soil health with AB Solution for fruit finishing to ensure long-term sustainability.

5. Conclusion

This study successfully evaluated the influence of different fertilization methods on the sweetness levels of the Jupiter variety of *Vitis vinifera* in a controlled greenhouse environment. The findings demonstrate that the use of AB Solution liquid fertilizer significantly enhances fruit sweetness, achieving a maximum Brix level of 27% compared to 20% for NPK chemical fertilizer and 17% for organic fertilizer. This indicates that potassium-rich liquid nutrients are highly effective for sugar accumulation in grapes grown under tropical greenhouse conditions.

While the results suggest that AB Solution can improve the primary quality metric of sweetness, it is important to note that "fruit quality" is a multifaceted concept. This research focused specifically on Brix levels, and further studies are required to quantify other quality parameters such as berry weight, diameter, and shelf life to provide a more holistic assessment of yield quality.

Furthermore, while this study offers preliminary insights for grape cultivation in Malaysia's unique climate, the results are currently limited to controlled greenhouse settings. To provide fully validated practical recommendations for local farmers, future research should include open-field trials and economic cost-benefit analyses of the various fertilization strategies. Ultimately, these findings contribute to a growing body of knowledge aimed at optimizing viticulture practices in tropical regions.

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References

[1] Brown, J., and M. Lewis. 2017. "The Role of Potassium in Grape Quality: Sugar Accumulation and Disease Resistance." *Journal of Wine Research* 28, no. 3: 190-200.

[2] Miliordos, Dimitrios Evangelos, Alexandros Kanapitsas, Despina Lola, Elli Goulioti, Nikolaos Kontoudakis, Georgios Leventis, Myrto Tsiknia, and Yorgos Kotseridis. "Effect of nitrogen fertilization on Savvatiano (Vitis vinifera L.) grape and wine composition." *Beverages* 8, no. 2 (2022): 29. https://doi.org/10.3390/beverages8020029

[3] Spayd, S. E., R. L. Wample, R. G. Stevens, R. G. Evans, and A. K. Kawakami. "Nitrogen fertilization of White Riesling in Washington: effects on petiole nutrient concentration, yield, yield components, and vegetative growth." *American Journal of Enology and Viticulture* 44, no. 4 (1993): 378-386. https://doi.org/10.5344/ajev.1993.44.4.378

[4] Smith, K., and T. Roberts. 2020. "Evaluating the Effects of Temperature and Nutrient Uptake on *Vitis vinifera* Ripening Stages." *Journal of Agricultural and Food Chemistry* 68, no. 4: 290-299.

[5] Jones, G. V., et al. 2021. "Fertilization or Supplement? Understanding the Role of Nitrogen in Vineyard Management." *Wine Business Monthly*, March 2021.

[6] Gatti, M., et al. 2023. "Effects of the Annual Nitrogen Fertilization Rate on Vine Production Parameters: A Meta-analysis." *International Journal of Agronomy* 2023, Article ID 7989254.

[7] Garcia, E., and F. Lopez. 2022. "The Impact of Soil Amendments and Fertilizers on *Vitis vinifera* Fruit Quality: A Systematic Review." *Journal of Agricultural Science* 14, no. 2: 110-128.

[8] Santos, A. O., et al. 2017. "Some Aspects on Growth, Yield, Phenology, and Grape Quality of 'Isabella' Grapevine (*Vitis × Labruscana*) Grown in a Pot System in Sandakan, Sabah, Malaysia." *Transactions on Science and Technology* 6, no. 2-2: 235-252.

[9] Bell, Sally-Jean, and Alan Robson. "Effect of nitrogen fertilization on growth, canopy density, and yield of Vitis vinifera L. cv. Cabernet Sauvignon." *American Journal of Enology and Viticulture* 50, no. 3 (1999): 351-358. https://doi.org/10.5344/ajev.1999.50.3.351