Production of Three Soybeans Varieties in Response to Gibberellin Concentration

Ariani Syahfitri Harahap, Suryani Sajar, Windri Yani

Abstract
The purpose of this study was to determine the growth of three soybean varieties against gibberellin concentration. The study was conducted in Sampecita Village, Kutalimbaru District, Deli Serdang Regency, North Sumatra, which was carried out from November 2024 to January 2025. This study used a factorial Randomized Block Design (RAK) experimental design consisting of 2 treatments, namely varieties (Dering 1, Dega 1 and Devon 1) and gibberellin immersion, namely: 0 ppm, 20 ppm, 40 ppm and 60 ppm which were repeated 3 times. The research data were analyzed and continued with the Duncan's mean difference test (DMRT). The results of the study showed that soybean crop production by variety showed a significant effect on the parameters of the number of pods per sample, the number of pods per plot and had no significant effect on the parameters of seed weight per sample, seed weight per plot and weight of 100 seeds. The gibberellin treatment and the interaction of the two showed no significant effect on all parameters.

Keywords: Production, Variety, Soybean, Concentration, Gibberellin

Ariani Syahfitri Harahap[1]
[1]bachelor of Agriculture, Universitas Pembangunan Panca Budi, Indonesia
e-mail: arianisyahfitri@dosen.pancabudi.ac.id[1]

Suryani Sajar[2], Windri Yani[3]
[2,3]bachelor of Agriculture, Universitas Pembangunan Panca Budi, Indonesia
e-mail: suryanisajar@yahoo.com[2], windriyan@gmail.com[3]
2nd International Conference on Islamic Community Studies (ICICS)
Theme: History of Malay Civilisation and Islamic Human Capacity and Halal Hub in the Globalization Era
Https://Proceeding.Pancabudi.Ac.Id/Index.Php/Icie/Index

Introduction

Soybean (Glycine max [L.] Merrill.) is the third most important food commodity after rice and corn. Soybeans can be consumed directly and are used as raw materials for agro-industries producing tofu, tempeh, tauco, oncom, soybean oil, soy sauce, soy milk, as well as for the animal feed industry (Adisarwanto, 2014).

Soybeans serve as a very important source of plant-based protein in improving community nutrition because they are safe for health and relatively inexpensive compared to animal-based protein sources. The nutritional content of soybeans per 100 g is as follows: 331.0 kcal of calories, 34.9 g of protein, 18.1 g of fat, 34.8 g of carbohydrates, 4.2 g of fiber, 227.0 mg of calcium, 585.0 mg of phosphorus, 8.0 mg of iron, and 1.0 mg of vitamin B1 (Bakhtiar et al. 2014).

The demand for soybeans continues to increase along with the growing population and the need for raw materials in the food processing industry; however, domestic soybean production remains low. In 2021, Indonesia imported 2.49 million tons of soybeans, valued at US$1.48 billion. According to the Central Statistics Agency in 2022, soybean production over the past ten years (2013-2021) has been quite fluctuating. The harvested area for soybeans has declined from 2015 to 2021. One of the causes of the shrinking harvested area is that domestic soybean prices are unable to compete with international soybean prices, resulting in farmers having little incentive to grow soybeans (BPS, 2022).

Efforts to increase soybean production continue to be carried out. One such effort involves the use of growth regulators. Growth regulators are non-nutrient organic compounds that, in low concentrations, can stimulate, inhibit, or qualitatively alter the growth and development of plants. One of the most commonly used growth regulators is gibberellin (GA3), which plays a role in influencing various physiological processes in plants. According to Pin et al. (2019), gibberellin is a plant growth regulator (PGR) that optimizes both vegetative and generative growth in plants, thereby enhancing flowering and the filling of fruits or seeds. The application of GA3 concentrations to plants can stimulate plant growth by increasing plant height and leaf area. The effectiveness of GA3 administration is also affected by the concentration used, as the required concentration varies for each plant species. The proper concentration of GA3 can stimulate plant growth (Yasmin, 2014).

Materials And Methods

This research was conducted at the research field of Universitas Pembangunan Panca Budi, Dusun 3 Sampe Cita Village, Kutalimbaru Subdistrict, Deli Serdang Regency, North Sumatra, at an altitude of approximately 24 meters above sea level. The research was carried out from November 2024 to January 2025. The materials used in this study included soybean seeds of the Dega 1, Deing 1, and Devon 1 varieties, polybags, topsoil, solid organic fertilizer from cow manure, and Gibberellin (GA3). The equipment used in this research consisted of hoes, raffia rope, measuring tapes, watering cans, saws, digital scales, writing tools, and other supporting research equipment.

This research was conducted using a Factorial Randomized Block Design (RAK) consisting of 2 factors, namely variety (Dega 1, Dering 1, Devon 1) and gibberellin (control, 20 ppm, 40 ppm, 60 ppm), with 3 replications, resulting in a total of 144 plants. Data showing significant differences will be tested using the DMRT test at the 5% level. The observed parameters include the number of pods per sample, number of pods per plot, seed weight per sample, seed weight per plot, and weight of 100 seeds.

Results

Number of Pods per Sample (fruit)

Based on the results of data analysis, it was shown that the variety treatment had a significant effect, while the gibberellin treatment and the interaction between the two did not have a significant effect on the parameter of the number of pods per soybean plant sample. The average number of pods per soybean plant sample can be seen in Table 1.

Table 1. Average Number of Pods per Sample (fruit) of Three Soybean Varieties in Response to Gibberellin Concentration

Treatment	Number of Pods per Sample (fruit)
Variety	
Dega 1	28.58 c
Dering 1	33.36 b
Devon 1	37.56 a
Gibberellin Concentration	
0 ppm	26.30 a
20 ppm	30.85 a
40 ppm	38.15 a
60 ppm	37.37 a

Description: Numbers followed by the same letter in the same column indicate no significant effect, while different letters in the same column indicate a significant effect at the 5% level according to the DMRT test.

Table 1 shows that the soybean variety treatments with the highest number of pods per sample was found in the Devon 1 variety, with 37.56 pods, which had a significant effect compared to the Dering 1 variety, with 33.36 pods, and the lowest was in the Dega 1 variety, with 28.058 pods. This indicates that certain soybean varieties have a positive influence on the growth and yield of soybean plants. Each variety possesses different genetic advantages, so each one has a different yield, depending on the characteristics of the plant variety itself (Sarawa et al., 2014).

Table 1 shows that the application of gibberellin to soybeans resulted in the highest number of pods per sample at the 40 ppm concentration, with 38.15 pods. This was not significantly different from the 60 ppm concentration, which had 37.37 pods, the 20 ppm concentration with 3.85 pods, and the lowest at the 0 ppm concentration with 26.30 pods. Gibberellin (GA3) can facilitate plant height growth, bud formation, seed germination, and increase the number of leaves. In addition, gibberellin also plays a role in the formation of flowers and fruits (Yasmin et al., 2016).

Number of Pods per Plot (fruit)

Based on the results of data analysis, it was found that the variety treatment had a significant effect, while gibberellin and their interaction had no significant effect on the parameter of the number of pods per plot in soybean plants. The average number of pods per plot in soybean plants can be seen in Table 2.

Table 2. Average Number of Pods per Plot (fruits) of Three Soybean Varieties in Response to Gibberellin Concentration

Treatment	Number of Pods per Plot (fruit)
Variety	
Dega 1	73.75 b
Dering 1	74.42 b
Devon 1	80.75 a
Gibberellin Concentration	
0 ppm	71.67 a
20 ppm	74.33 a
40 ppm	78.11 a
60 ppm	81.11 a

Description: Numbers followed by the same letter in the same column indicate no significant effect, while different letters in the same column indicate a significant effect at the 5% level according to the DMRT test.

Table 2 shows that the soybean variety treatment with the highest number of pods per plot was found in the Devon 1 variety with 80.75 pods, which had a significant effect compared to the Dering 1 variety with 74.42 pods, and the lowest was in the Dega 1 variety with 73.75 pods. This is thought to be due to the influence of the dominant genetic traits of the variety, which is also supported by suitable growing conditions, resulting in varieties with higher yield potential. This is in line with the statement that varieties play an essential role in the development of soybean cultivation to achieve high productivity, which is greatly determined by the yield potential of the superior varieties planted (Gabesius et al., 2012).

Table 2 shows that the gibberellin treatment on soybeans resulted in the highest number of pods per plot at a concentration of 60 ppm, with 81.11 pods, which was not significantly different from the concentration of 40 ppm, with 78.11 pods, the concentration of 20 ppm, with 74.33 pods, and the lowest at a concentration of 0 ppm, with 710.67 pods. According to the research by Azizi et al. (2012), spraying gibberellin at a concentration of 125 ppm produced the highest yield (4.24 t/ha), whereas spraying gibberellin at a concentration of 375 ppm resulted in a yield of 1.62 t/ha. This indicates that administering gibberellin at high concentrations decreases soybean yields.

Seed Weight per Sample (g)

Based on the results of data analysis, it shows that the variety, gibberellin, and their interaction have no significant effect on the parameter of seed weight per soybean plant sample. The mean seed weight per soybean plant sample can be seen in Table 3.

Table 3. Average Seed Weight per Sample (g) of Three Soybean Varieties in Response to Gibberellin Concentration

Treatment	Seed Weight per Sample (g)
Variety	
Dega 1	19.86 a
Dering 1	16.78 a
Devon 1	21.11 a

Gibberellin Concentration	
0 ppm	13.89 a
20 ppm	17.44 a
40 ppm	25.00 a
60 ppm	20.67 a

Description: Numbers followed by the same letter in the same column indicate no significant effect at the 5% level according to the DMRT test.

Table 3 shows that the soybean variety treatment with the highest seed weight per sample was found in the Devon 1 variety at 21.11 g, which did not have a significant effect compared to the Dega 1 variety at 19.86 g, and was lowest in the Dering 1 variety at 16.78 g. The soybean yields have approached the average seed yield described in the profiles of superior soybean varieties released by the Legume and Tuber Crops Research Institute (Balitkabi, 2017).

Table 3 shows that the gibberellin treatment on soybeans resulted in the highest seed weight per sample at a concentration of 40 ppm, with 25 g, which did not have a significant effect compared to the concentration of 60 ppm at 20.67 g, 20 ppm at 17.44 g, and the lowest at 0 ppm with 13.89 g. Gibberellin has the ability to control certain environmental conditions that can regulate the growth of flowers and seeds (Berson et al., 2016).

Seed Weight per Plot (g)

Based on the results of data analysis, it was shown that the effect of variety, gibberellin, and their interaction on the parameter of seed weight per plot of soybean plants was not significant. The average seed weight per plot of soybean plants can be seen in Table 4.

Table 4. Average Seed Weight per Plot (g) of Three Soybean Varieties in Response to Gibberellin Concentration

Treatment	Seed Weight per Plot (g)
Variety	
Dega 1	81.08 a
Dering 1	67.42 a
Devon 1	89.50 a
Gibberellin Concentration	
0 ppm	52.56 a
20 ppm	78.11 a
40 ppm	94.78 a
60 ppm	91.89 a

Description: Numbers followed by the same letter in the same column indicate no significant effect at the 5% level according to the DMRT test.

Table 4 shows that the highest seed weight per plot in soybean variety treatments was found in the Devon 1 variety at 89.50 g, which was not significantly different from the Dega 1 variety at 81.08 g, and the lowest was in the Dering 1 variety at 67.42 g. According to Naeve (2018), yield potential is indeed a key factor in soybean variety selection, with yield potential accounting for 80% of success, while the remaining 20% involves identifying the best variety for each location or environmental condition. Furthermore, it is stated that the genetic base for soybean varieties is quite narrow, and each variety has its own strengths and weaknesses.

Table 4 shows that the gibberellin treatment on soybeans resulted in the highest seed weight per plot at a concentration of 40 ppm, reaching 94.78 g. This effect was not significantly different from the concentration of 60 ppm at 91.89 g, the concentration of 20 ppm at 78.11 g, and the lowest was at a concentration of 0 ppm at 52.56 g. This indicates that the application of plant growth regulators at low concentrations will not produce significant changes in the plants, whereas application at excessively high concentrations will actually result in a decrease (Adnan et al, 2017).

Weight of 100 Seeds (g)

Based on the results of data analysis, the effects of variety, gibberellin, and their interaction on the parameter of 100-seed weight in soybean plants were not significant. The average 100-seed weight of soybean plants can be seen in Table 5.

Table 5. Average Weight of 100 Seeds (g) of Three Soybean Varieties in Response to Gibberellin Concentration

Treatment	Weight of 100 Seeds (g)
Variety	
Dega 1	15.67 a
Dering 1	15.42 a
Devon 1	15.83 a
Gibberellin Concentration	
0 ppm	14.89 a
20 ppm	15.56 a
40 ppm	15.78 a
60 ppm	16.33 a

Description: Numbers followed by the same letter in the same column indicate no significant effect at the 5% level according to the DMRT test

Table 5 shows that the soybean variety treatments resulted in the highest 100-seed weight in the Devon 1 variety at 15.83 g, which was not significantly different from the Dega 1 variety at 15.67 g, and the lowest was found in the Dering 1 variety at 15.42 g. Ratnasari et al. (2015) stated that soybean productivity can be increased by improving cultivation techniques through the use of superior varieties, as each variety will exhibit different growth responses and production levels. Each variety has different genetic traits, so these genetic differences can lead to varied responses to the environment and production factors.

Table 5 shows that the gibberellin treatment in soybeans resulted in the highest 100-seed weight at a concentration of 60 ppm, reaching 16.33 g, which did not significantly differ from the 40ppm concentration at 15.78 g, the 20 ppm concentration at 15.56 g, and the lowest at 0 ppm at 14.89 g. Gibberellin can regulate specific environmental conditions that control flower growth. Gibberellin stimulates flower growth, which in turn promotes the formation of fruits and seeds (Berson et al., 2015).

Conclusion

The results of the study showed that the Devon 1 variety and a concentration of 60 ppm exhibited good growth in soybean plants.

Reference

[1] Adisarwanto, T. 2014. Tropical Soybean Cultivation. 10th Printing. Revised Edition. Jakarta: Penebar Swadaya. 24 pages.

[2] Adnan, B. R. Juanda, and M. Zaini. 2017. Effect of Concentration and Duration of Soaking in Auxin PGR on the Viability of Expired Watermelon Seeds (Citrullus lunatus). Agrosamudra Journal. 4(1): 45-57.

[3] Azizi Kh., Moradii, J., Heidari, S., Khalili, A., and Felzian, M. 2012. Effect of different concentrations of gibberellic acid on seed yield and yield components of soybean genotypes in summer intercropping. *Internatoinal Journal of Agriscience*. 2(4): 291—300.

[4] Central Bureau of Statistics. (2022). Developments in Production, Harvested Area, and Productivity of Soybeans in Indonesia, 2016-2021. Jakarta: BPS.

[5] Bakhtiar, T. Hidayat, Yadi, J. and S. Safriati. 2014. Growth performance and yield components of several superior soybean varieties in Aceh Besar. J. Floratek 9: 46-52.

[6] Balitkabi. (2017). Description of Superior Varieties of Legumes and Tubers. Malang: Balitkabi.

[7] Berson, Mariati, and Rosita. 2015. Seed production of Samosir shallot accession Simando in response to GA3 concentration and soaking duration in the Samosir highlands. J. Online Agroecotechnology 3(3): 1147-1146.

[8] Gabesius, Y.O. Siregar, L.A.M. and Husni. Y. 2012. Growth and production response of several varieties of...delai terhadap pemberian pupuk bokashi. Jurnal Online Agroekoteknologi 1 (1) : 220-236.

[9] Naeve, S. L. 2018. Choosing the best soybean varieties for your field. Extension Agronomist.

[10] Pin, S., Sreewongchai, T., & Damrongvudhi, O. 2019. Effects and chemical contents of hydrolysis modification of aqueous roselle extract to reflect the antioxidant and anti-inflammatory effects. Science and Technology Asia. 24(4): 126–134.

[11] Ratnasari, D., M.K. Bangun and R.I. M. Damanik. 2015. Response of Two Soybean Varieties (Glycine max L. Merill.) to the Application of Biofertilizer and Compound NPK Fertilizer.

[12] Sarawa, Anas, A. A., & Asrida. (2014). Patterns of Photosynthate Distribution during the Vegetative Phase of Several Soybean Varieties on Acidic Soils in Southeast Sulawesi. Jurnal Agroteknos, 4 (1), 26–31.

[13] Yasmin, S., T. Wardiyati, and Koesriharti. 2014. The Effect of Different Application Times and Concentrations of Gibberellin (GA3) on the Growth and Yield of Large Chili Plants (Capsicum annum L.). J. Plant Production 2(5): 395-403.