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Effect of amino acid administration on generative growth and brix value of sugarcane plant (*Saccharum officinarum* L.) Bululawang varieties

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Abstract:
Sugarcane (*Saccharum officinarum* L.) is a strategic crop that is the primary raw material for sugar and has an important role in the economy. Domestic sugar production has not met national needs due to various constraints, such as low yield, poor seed quality, and soil damage due to inorganic fertilizers. The application of amino acids as organic fertilizers can potentially increase sugarcane productivity by improving plant metabolism and soil microbial activity. This study aimed to determine the effect of amino acid administration on generative growth and the Brix value of sugarcane plants (*Saccharum officinarum* L.). Varieties of sea lining. The research was implemented from February to June 2024 at the Lapang Laboratory, Department of Agricultural Production, Politeknik Negeri Jember. The method used in the study is the Group Random Design (RAK) method, which involves 1 factor, namely, Amino Acid organic fertilizer has four levels of amino acid dosage, namely A0 = Control (without amino acid administration), A1 = Amino Acid 250 ml/polybag, A2 = Amino Acid 500 ml/polybag and A3 = Amino Acid 750 ml/polybag. The data obtained from the research results was analyzed using ANOVA and then further tested using BNJ at the level of 5%. The results of the study found that the application of amino acids to sugarcane plants (Saccharum officinarum L.) had a real effect on the height of the plant at 188 HST, the stem diameter of 218 and 249 HST, and very real on the stem diameter of 188 HST and the root volume of 249 HST. However, the effect was not significant on the plant height of 218 HST, 249 HST, and Brix values.

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INTRODUCTION

One of the commodity crops in the plantation subsector that is the main raw material in sugar production is sugarcane plants (*Saccharum officinarum* L.). Sugarcane plants are raw materials for the food industry that are important for daily life, both on a household and industrial scale. According to the Badan Pusat Statistik (2023), the area of sugarcane plantations in Indonesia will reach 488,900 hectares in 2022, making it one of the strategic commodities that play an important role in the Indonesian economy, especially as the main raw material for sugar.

The main raw material of sugar not only plays a strategic role in the national economy but also becomes a source of income for the community. Domestic sugar production reached around 2.35 million tons in 2022, while the demand for sugar for public consumption reached 2.8 million tons (Dinas Kominfo Jawa Timur, 2025). This shortage shows the importance of increasing sugarcane

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May 2025
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productivity to meet domestic needs. Some of the factors that can cause a decline in national sugar production include decreased productivity of sugarcane crops, low sugarcane yield values, uncertain climate, and poor seed quality. In addition, fertilization that has been over-reliant on inorganic fertilizers can cause soil damage and reduce the quality of the planting medium. Long-term use of inorganic fertilizers can result in the accumulation of synthetic chemicals that damage soil structure (Jannah et al., 2022).

Seeing the importance of sugarcane in the sugar industry, a solution is needed to overcome this problem, one of which is the provision of organic fertilizers such as amino acids. Amino acids are organic compounds that have the functional groups of carboxyl (-COOH) and amine (-NH2). Amino acids are nutrients for soil microbes. The application of amino acids into the soil will increase the activity and population of beneficial microbes (Syukur, 2021). Research by (Pratiwi, 2023) shows that the administration of amino acids to melon plants can increase plant height, leaf count, and yield, including the weight and sweetness level of the fruit. According to (Rohmanto, 2024), amino acids play a role in increasing soil microbial activity and supporting the process of nutrient assimilation by plant roots. Based on the description above, further research is needed on the effect of amino acid administration on generative growth and the value of Brix sap of sugarcane plants (Saccharum officinarum L.) of the Bululawang variety.

One of the sugarcane varieties that is often used by farmers and is categorized as superior by having adaptability and stability in various types of soil, including high yield value, which is around 7.51%, is the Bululawang variety of sugarcane. The characteristics of the Bululawang variety of sugarcane are the production potential with a sugarcane yield of 94.3 tons/ha, a yield of 7.51%, and a crystal sugar of 6.90 tons/ha. The Bululawang variety of sugarcane is a variety of sugarcane that has a medium to slow lifespan. In Indonesia, Bululawang variety sugarcane is widely cultivated on the islands of Java and Sumatra (Praseptiana et al., 2017).

The Bululawang variety of sugarcane was first found in the Bululawang District area, southern Malang. This variety of sugarcane has morphological characteristics that include traits ranging from stems, leaves, and eyes. Based on the information listed in the variety pocket book from PTPN XI PG Jatiroto, the morphological characteristics of the Bululawang variety of sugarcane are that it has reddish-brown sugarcane stalks, medium waxy layers, flat circular growth rings at the top of the eyelids, yellowish-green leaves with long leaf sizes widened, slightly curved less than half and tend to be upright on the leaf curve, leaf ears that have weak to medium growth with an oblique position, dense back feather leaves and form a wide strip. The bud eyes are located at the base of the leaf fronds, triangular with wing edges, and are equipped with cilia hair and crested hair (Ramadhani, 2012).

METHOD

Time and Place of Execution

Final Project research was implemented from February to June 2024 at the Lapang Laboratory of the Department of Agricultural Production, Politeknik Negeri Jember.

Tools and materials

The tools used in the study include: Hoes, Scythes, Shovels, Argo, Hoses, Buckets, Meters, Calipers, Brix Refractometers, and Polybags 60 x 60 cm. The materials used in the study include: Topsoil, Sand, Compost fertilizer, za fertilizer, amino acids, and 5-month-old sugarcane plants.

Volume 01 Number 01
May 2025
p-ISSN: 3124-7865
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Volume 01 Number 01
May 2025
p-ISSN: 3124-7865
e-ISSN: 3124-8179

Research Methods

The method used in the study is the Group Random Design (RAK) method, which involves 1 factor, namely, Amino Acid organic fertilizer, has 4 levels of amino acid dosage:
A0 : Control (without amino acid administration)
A1 : Amino Acids 250 ml/polybag
A2 : Amino Acids 500 ml/polybag
A3 : Amino Acids 750 ml/polybag

Each treatment was repeated 6 times so that there were 24 experimental units, each unit consisting of 6 plants and 3 plants as sample plants. The linear model (RAK) is as follows:

$Yij = \mu + ti + \alpha j + \sum ij$

Information:
Yij : The observation value of the treatment of the i-i-repetition-j
μ : General average
αj : Effect of the treatment of amino acids to j
ti : The influence of Deuteronomy I
∑ij : Experimental error of the amino acid treatment to the j and the ith test

Research Implementation

The following are the work steps for each stage of research implementation:
1. Planting Media Manufacturing
   a. Prepare the tools and materials to be used
   b. Sifting sand, topsoil, and manure in a ratio of 2 : 1 : 2, namely: 2 topsoils, 1 sand, and 2 manure
   c. Preparing plants to be moved from a 40 x 40 polybag to a 60 x 60 polybag
   d. Put sand, topsoil, and manure that have been mixed evenly into a 60 x 60 polybag on plants that have been moved according to the predetermined dose.
2. Plant Transplant
   a. Preparing tools and materials to carry out the transplantation of sugarcane plants
   b. Moving plants from 40 x 40 polybag media to 60 x 60 polybag
   c. After transplanting, the plant is watered sufficiently
3. Application of Amino Acids
   a. Prepare tools and materials used in applying amino acids to sugarcane plants that have been transplanted
   b. Apply amino acid liquid fertilizer with concentrations of 250, 500, and 750 ppm per treatment
   c. Applying Amino Acids to plants by watering them in polybag media
4. Plant maintenance
   a. Carry out weed removal on the plant area.
   b. Provide additional fertilizer such as ZA as much as 10 grams before harvest at the age of 8 months in each treatment
   c. Watering 1 to 2 times daily.

Volume 01 Number 01
May 2025
p-ISSN: 3124-7865
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Observation Parameters

The parameters of the observations used for this study include:

a. Plant height (cm)
   Plant height measurement is carried out when the plant is 7 months old, after the plant is transferred into the medium, and observed once every 1 month until the plant is 9 months old. The height measurement of the plant is carried out from the base of the stem to the highest leaf shoots using a meter.
b. Stem Diameter (mm)
   The stem diameter was observed when the plant was 7 months old, after being transferred into the medium, and observed once every 1 month until the plant was 9 months old. The diameter of the rod was measured 10 cm above the ground level using a caliper.
c. Brix value
   Using a Brix refractometer, sugar levels were observed at the time of the last observation on 9-month-old plants by cutting the sugarcane plant into three parts, including the rootstock, middle stem, and upper stem.
d. Root volume
   Root volume was observed at the end of the observation of 9-month-old plants. The volume of the roots is observed by inserting the roots in a bucket marked on a scale of ml, then observing the difference in water volume before and after the roots are inserted.

RESULT

Data obtained from the observation of all parameters in the final project activity with the title "The Effect of Amino Acid Administration on Generative Growth and Brix Value of Sugarcane Sap Plant (*Saccharum officinarum* L.) Bululawang Variety" was analyzed using the F Test (ANOVA) and further tested using BNT (Smallest Real Difference) at the level of 5%. The test results for each parameter are presented in Table 1.

Table 1. Anova Results Summary

Parameter	Plant Age	F Calculate	F Table 5%	F Table 1%	Conclusion	Coefficient of Variation
Plant Height	188 HST	4.98	3.29	5.42	*	8%
	218 HST	2.03	3.29	5.42	ns	4%
	249 HST	2.43	3.29	5.42	ns	7%
Diameter Batang	188 HST	5.51	3.29	5.42	**	8%
	218 HST	4.27	3.29	5.42	*	7%
	249 HST	4.02	3.29	5.42	*	7%
Root Volume	249 HST	5.74	3.29	5.42	**	1%
Brix	249 HST	1.49	3.29	5.42	ns	9%

Information :
ns = Non-significant (has an intangible effect)
** = Very real influence
* = Have a real impact
HST = Day After Planting

Plant Height

Plant height parameters were observed on plants aged 188 HST, 218 HST, and 249 HST. The results of the ANOVA analysis in Table 2 show that amino acid administration had a significant effect

Volume 01 Number 01
May 2025
p-ISSN: 3124-7865
e-ISSN: 3124-8179

on the height parameters of plants at the age of 188 HST. Because it has a real effect, a follow-up test of 5% BNT is carried out.

Table 2. Average Height of Sugarcane Plants (cm)

Treatment	188 HST BNT (23.74)	218 HST	249 HST
A0	203.8 a	264.7	293.3
A1	232.6 b	276.9	309.8
A2	239.3 b	276.1	319.8
A3	242.2 b	277.9	325.8

Remarks: Numbers followed by different letters show significantly different results based on the 5% BNT follow-up test
A0 :Control
A1 : 250 ml/ polybag
A2 : 500 ml/ polybag
A3 : 750 ml/ polybag

Stem Diameter

Stem diameter parameters were observed on plants aged 188 HST, 218 HST, and 249 HST. The results of the ANOVA analysis in Table 3 of amino acid administration showed that it had a very significant effect on the rod diameter parameters at the age of 188 HST and had a significant effect on the age of 218 HST and 249 HST. Because it has a real and very real effect, a follow-up test of 5% BNT is carried out.

Table 3. Average Stem Diameter of Sugarcane Plants (mm)

Treatment	188 HST BNT (2.94)	218 HST BNT (2.84)	249 HST BNT (2.85)
A0	27.23 a	28.93 a	30.06 a
A1	29.04 from	30.19 a	31.59 a
A3	30.75 bc	31.49 from	32.63 from
A2	32.58 c	33.48 b	34.58 b

Remarks: Numbers followed by different letters show significantly different results based on the 5% BNT follow-up test
A0 :Control
A1 : 250 ml/ polybag
A2 : 500 ml/ polybag
A3 : 750 ml/ polybag

Root Volume

Root volume parameters were observed on plants aged 249 HST. The results of the ANOVA analysis in Table 4 show that amino acid administration had a very significant effect on the root volume parameters at the age of 249 HST. Because the effect is very real, a follow-up test of BNT 5% was carried out.

Table 4. Advanced Test BNT 5% Root Volume Parameter (ml)

Treatment	249 HST BNT (176.15)
A0	12302.8 a
A1	12497.2 b
A2	12636.1 b
A3	12538.9 b

Remarks: Numbers followed by different letters show significantly different results based on the 5% BNT follow-up test
A0 :Control
A1 : 250 ml/ polybag
A2 : 500 ml/ polybag

Volume 01 Number 01
May 2025
p-ISSN: 3124-7865
e-ISSN: 3124-8179

A3 : 750 ml/ polybag

The table shows a noticeable effect of amino acid administration on increasing root volume. Based on the 5% BNT test data, the root volume of the control plant (A0) had the lowest average value of 12302.8 ml. Amino acid administration at different doses (A1, A2, and A3) significantly increased root volume compared to controls. The root volume tended to be higher in the A2 treatment (12636.1 ml), followed by A3 (12538.9 ml) and A1 (12497.2 ml). From the 5% BNT follow-up test, treatments A1, A2, and A3 showed no noticeable difference from each other but were significantly different from the control (A0).

Figure 1. Roots of Sugarcane Plants

Brix

The results of the ANOVA test showed that the effect of amino acid administration on the Brix value of sugarcane plants (*Saccharum officinarum* L.) was not statistically significant. However, the graph presented shows a variation in the Brix value between treatments. The A2 treatment (500 ml/polybag) resulted in a higher Brix value of 18.5%, followed by A1 (17.6%), A3 (17.2%), and A0 (16.6%). This indicates that, although not statistically significant, amino acid administration provides potential biological benefits such as increased sugar concentrations in sugarcane sap.

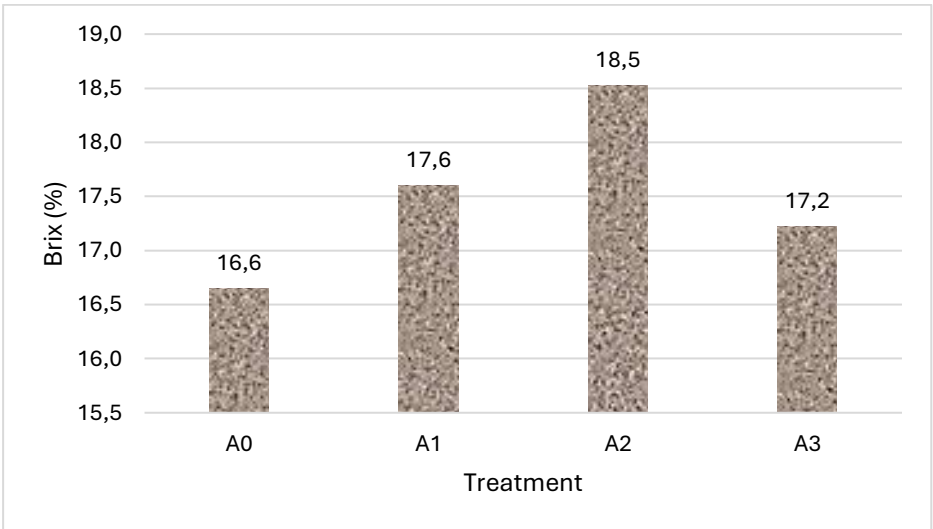

Figure 2. Diagram of Brix

Volume 01 Number 01
May 2025
p-ISSN: 3124-7865
e-ISSN: 3124-8179

DISCUSSION

Plant Height

The observations on the height of sugarcane plants (*Saccharum officinarum* L.) showed that the administration of amino acids significantly affected the age of 188 HST based on the follow-up test of BNT at 5%. Treatments A1 (250 ml/polybag), A2 (500 ml/polybag), and A3 (750 ml/polybag) showed significantly different results compared to controls (A0). The A3 treatment resulted in a higher plant height of 242.2 cm, followed by A2 (239.3 cm), A1 (232.6 cm), and A0 (203.8 cm). This suggests that the administration of amino acids, especially at higher doses, has a positive effect on the high growth of plants in the early phases of observation. Observations at the ages of 218 HST and 249 HST, although there was no real difference based on the follow-up test of BNT, showed a trend of increasing the height of the plants in the amino acid treatment compared to the controls. At 218 HST, the plant height tended to be higher achieved by the A3 treatment (277.9 cm), while at 249 HST, A3 still produced a higher plant height tended to be higher by 325.8 cm, followed by A2 (319.8 cm), A1 (309.8 cm), and A0 (293.3 cm).

The administration of amino acids has an important role in increasing plant growth. Amino acids act as precursors in synthesizing plant hormones, such as auxin, which directly contribute to the high growth of plants. Previous research by Fitriani et al. (2015) showed that the application of amino acids can increase plant height through their effect on enzyme activity and nutrient availability, as well as increase the formation of sugarcane shoots in vitro. In addition, amino acids also play a role in improving nutrient absorption and tolerance to environmental stress, which in turn can stimulate overall plant growth (Mastur et al., 2015).

Stem Diameter

Based on the observation results of the average stem diameter of sugarcane plants (Saccharum officinarum L.), the application of amino acids had a significant effect on this parameter at all observation ages (188 HST, 218 HST, and 249 HST) based on the 5% BNT follow-up test. At 188 HST, the A2 treatment (500 ml/polybag) resulted in a higher rod diameter of 32.58 mm, significantly different from the other treatments. The A3 treatment (750 ml/polybag) also showed a significantly higher rod diameter than the control (A0), but lower than the A2. The A1 treatment (250 ml/polybag) showed no significant difference in results from the control (A0). At age 218 HST, a similar trend was observed, where A2 still produced a higher rod diameter (33.48 mm), significantly different from A0 and A1. The A3 treatment (31.49 mm) was between A2 and A1, significantly improving over A0 but not as high as A2. At age 249 HST, the A2 treatment again showed a higher rod diameter (34.58 mm), followed by A3 (32.63 mm), A1 (31.59 mm), and A0 (30.06 mm).

The administration of amino acids plays an important role in supporting stem growth through increased nutrient availability and plant hormone synthesis. Research by Putra et al. (2022) states that amino acid-based fertilizers can improve cellular structure and increase photosynthetic activity, ultimately increasing shallot plants' dry and wet weights. In the context of sugarcane, the increase in stem diameter is directly related to the sap storage capacity, which contributes to sugar production. Amino acids can also increase plant resistance to environmental stress while improving the structure of stem tissue so that the stem diameter increases (Wiendil et al., 1996).

Root Volume

The administration of amino acids plays an important role in supporting plant root growth through increased physiological activity and nutrient availability. Research by Kosokot (2023) shows that applying amino acid-based organic fertilizers can increase the activity of soil microbes, which

Volume 01 Number 01
May 2025
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significantly supports the development of plant roots. In addition, hormones contained in amino acids, such as cytokinin and auxin, have a key role in supporting root growth. Auxin stimulates the elongation and differentiation of root cells, strengthening the plant's ability to absorb water and nutrients. According to (Karjadi & Buchory, 2008), auxins increase the formation of lateral roots and root hair, contributing to an increase in root volume. Cytokinins, on the other hand, aid cell division in the root meristem zone, accelerating the growth and expansion of the root system. The combination of these two hormones, stimulated by amino acids, creates a stronger and more efficient root system that supports the overall growth of the plant.

Brix

The Brix value is an indicator of the quality of sugarcane, which reflects the total sugar concentration in the sap. Photosynthetic activity and carbon metabolism are the main factors affecting the Brix value. Amino acids increase the activity of photosynthetic enzymes and plant metabolism, thereby supporting higher sugar production. According to Taiz et al. (2015), nitrogen, a component of amino acids, supports the formation of chlorophyll and photosynthetic activity. Efficient photosynthesis results in more carbon assimilation, ultimately contributing to increased Brix values. Research by Mastur et al. (2015) also shows that optimal nitrogen management in sugarcane plants can increase sugar yields through increased photosynthesis rates and metabolic efficiency. (Fitriani et al., 2015) stated that the administration of amino acids such as glycine, cysteine, and arginine helps increase carbon metabolism efficiency, thereby affecting the increase in sugar content.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the application of amino acids to sugarcane plants (*Saccharum officinarum* L.) has a real effect on the plant height of 188 HST, the stem diameter of 218 and 249 HST, and very noticeable on the stem diameter of 188 HST and the root volume of 249 HST. However, the effect was insignificant on the plant height of 218 HST, 249 HST, and Brix values.

The following research suggestion is expected to focus on the optimal dose of amino acids that can significantly increase the value of Brix. In addition, field research with conditions closer to reality can help test the effectiveness of amino acid administration on a broader scale.

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Volume 01 Number 01
May 2025
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