Analysis of the growth of two maize cultivars under various combinations of inorganic and bio-fertilization

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ABSTRACT

This study explores the impact of biofertilizer and inorganic fertilizer combinations, along with maize cultivar selection, on enhancing maize growth. Conducted from June to September 2024 in Sambirejo Village, Jombang, the research employed a factorial randomized block design (RBD) with two factors: fertilizer combinations (P) and maize cultivars (K), with three replications. Growth parameters such as stem diameter, leaf area, and growth rate were measured at 15, 30, 45, and 60 days after planting (DAP), along with nitrogen and phosphorus uptake at 60 DAP. Results indicated that the ADV Jago cultivar, when combined with 100% inorganic fertilizer and 10 ml of biofertilizer (P7), produced the largest leaf area at 60 DAP and showed the best growth rate from 45 to 60 DAP. The Hibrida P35 cultivar also responded well to the same fertilizer combination (P7), with a significant increase in stem diameter at 15 DAP. Lower fertilizer doses (75% and 50%) combined with 10 ml of biofertilizer (P8 and P9) yielded comparable results in terms of stem diameter and leaf area to the 100% inorganic fertilizer treatment.

Keywords: maize; growth analysis, biofertilizer; inorganic fertilizer, cultivar

INTRODUCTION

Maize (*Zea mays* L.) is a major food crop commodity in Indonesia due to the high demand for both staple food and raw materials for the livestock feed industry. Jombang Regency is one of the main maize production centers in East Java. In 2023, the maize productivity in Jombang Regency was recorded at 7.14 tons/hectare, which is higher compared to the 2022 productivity of 7.04 tons/hectare. However, the area of maize production land in Jombang Regency has decreased, with a harvested area of 38,290.60 hectares in 2022, which reduced to 38,113.70 hectares in 2023 (Badan Pusat Statistik Jombang Regency, 2023). Increasing the effectiveness of maize cultivation land can be achieved by improving soil fertility. Soil fertility is influenced by the chemical, physical, and biological conditions of the soil, as well as the quantity and balance of nutrients within the soil (Handayanto et al., 2017).

In the practice of improving soil fertility, farmers generally use high doses of inorganic fertilizers to maintain stable crop productivity. While this practice can meet the nutrient needs of maize in the short term, it can lower soil pH and cation exchange capacity in the long term, making the added inorganic fertilizers less effective in providing nutrients to maize plants (Murnita & Taher, 2021). Additionally, dependence on inorganic fertilizers increases production costs, especially as the government gradually phases out fertilizer subsidies, leading to a decline in farmers' profits due to the high cost of inorganic fertilizers. A potential approach to addressing land productivity issues is substituting or complementing the use of inorganic fertilizers with biofertilizers. Nutrient availability can be enhanced through increased plant access to nutrients, such as phosphate solubilization by phosphate-solubilizing microbes, or by the decomposition process facilitated by actinomycetes fungi or earthworms (Herdiyantoro & Setiawan, 2015).

Another aspect to consider, in addition to the appropriate use of fertilizers, is the choice of cultivar. It is essential to use superior varieties that have high yield potential and are resistant to diseases. In this study, the ADV Jago cultivar was selected for its high yield potential, high recovery rate, tolerance to lodging, tolerance to downy mildew, ease of threshing, and shiny orange kernels. The Hibrida P35 cultivar, on the other hand, is known for its resistance to maize downy mildew, shorter growing period, bright red kernels, and low moisture content, making it suitable for high market standards. This research is crucial as it highlights the importance of combining biofertilizers and inorganic fertilizers to enhance maize production across various cultivars. The optimization of fertilization through the combination of biofertilizers and inorganic fertilizers can be a sustainable solution to improving maize plant growth. As a result, this study could contribute to advancing sustainable agricultural practices, improving farmers' welfare, and enhancing national food security.

MATERIALS AND METHODS

The research was conducted from June to September 2024, in Sambirejo Village, Jogoroto Sub-district, Jombang Regency, at an altitude of 40 meters above sea level. The materials used in this study included maize seeds of the ADV

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Jago cultivar and Hibrida P35, NPK fertilizer (16:16:16), urea fertilizer, biofertilizer containing *Azospirillum sp, Rhizobium sp, Aspergillus niger, Trichoderma harzianum,* and *Pseudomonas fluorescens*, as well as pesticides. The method used was a factorial randomized block design (RBD) with two factors and three repetitions. Factor 1 was the combination of biofertilizer and inorganic fertilizer dosages, consisting of 9 treatment levels: 100% inorganic fertilizer + no biofertilizer (P1), 75% inorganic fertilizer + no biofertilizer (P2), 50% inorganic fertilizer + no biofertilizer (P3), 100% inorganic fertilizer + 5 ml biofertilizer (P4), 75% inorganic fertilizer + 5 ml biofertilizer (P5), 50% inorganic fertilizer + 5 ml biofertilizer (P6), 100% inorganic fertilizer + 10 ml biofertilizer (P7), 75% inorganic fertilizer + 10 ml biofertilizer (P8), and 50% inorganic fertilizer + 10 ml biofertilizer (P9). Factor 2 was the maize cultivar: ADV Jago (K1) and Hibrida P35 (K2). Observations included growth measurements, such as stem diameter, leaf area, and plant growth rate at 15, 30, 45, and 60 days after planting (DAP), as well as nitrogen (N) and phosphorus (P) uptake at 60 DAP. The data obtained from the observations were analyzed using variance analysis (F-test) at a 5% significance level. If significant differences were found, further analysis was conducted using the Least Significant Difference (LSD) test at a 5% significance level.

RESULTS AND DISCUSSION

Stem Diameter

The stem diameter plays a crucial role in the transportation of nutrients in plants. The research results showed an interaction effect between the combination of biofertilizer and inorganic fertilizer doses and cultivar type on the stem diameter of maize plants at 15 days after planting (DAP) (Table 1). The combination of 100% inorganic fertilizer + 10 ml biofertilizer (P7) in the Hibrida P35 cultivar produced the largest stem diameter, followed by the same treatment in the ADV Jago cultivar and the combination of 100% inorganic fertilizer + 5 ml biofertilizer (P4) in the ADV Jago cultivar. Stem growth reflects the cross-sectional area of nutrient transport tissues in the plant; the larger the stem diameter, the greater the cross-sectional area, thereby enhancing the rate of nutrient translocation (Sofyan et al., 2019).

The use of lower doses of inorganic fertilizer, 75% and 50%, in both the ADV Jago and Hibrida P35 cultivars, when combined with either 5 ml or 10 ml of biofertilizer, resulted in stem diameters that were not significantly different from those treated with 100% inorganic fertilizer. These results indicate that the addition of biofertilizer plays a crucial role in plant growth metabolism and can reduce the need for inorganic fertilizers in maize cultivation. Biofertilizers enhance nutrient availability as they contain nitrogen-fixing bacteria and phosphate-solubilizing bacteria, which also decompose organic matter into simpler compounds, making nutrients more accessible to plants (Lumbantoruan et al., 2021).

Different results were observed at 30, 45, and 60 days after planting (DAP), where no interaction was found between the combination of biofertilizer and inorganic fertilizer doses and cultivar type regarding the stem diameter of maize plants. The differences among maize cultivars did not significantly affect stem diameter; however, variations in the combination of biofertilizer and inorganic fertilizer doses had a significant effect on maize stem diameter (Table 2). At 30 DAP, the application of 100% inorganic fertilizer followed by the addition of biofertilizer, either 5 ml or 10 ml (P4 and P7), resulted in the highest stem diameter compared to other fertilizer combination treatments. At harvest age 45 and 60 DAP, the combination of 100% inorganic fertilizer + 10 ml biofertilizer (P7) produced a greater stem diameter than the other fertilizer combinations. The use of lower doses of inorganic fertilizer at 75% and 50%, when supplemented with either 5 ml or 10 ml of biofertilizer, resulted in stem diameters that were not significantly different from those treated with 100% inorganic fertilizer. This highlights the importance of an appropriate combination between biofertilizer and inorganic fertilizer doses in supporting the growth of maize stem diameter. Biofertilizers competitively colonize plant root systems, enhancing nutrient uptake, increasing productivity and crop yield, improving plants' tolerance to stress and their resistance to pathogens, and promoting plant growth through mechanisms such as the mobilization of essential elements, nutrients, and plant growth hormones. In addition to supporting root growth, flowering, and fruiting, these hormones aid in regulating plant growth and development (Daniel et al., 2022; Saha et al., 2023).

Leaf Area

Leaf area is an important parameter to observe in plant growth, as leaves are the sites of photosynthesis; therefore, a larger leaf area contributes positively to plant development. The results of the study indicated that the interaction between the combination of biofertilizer and inorganic fertilizer doses and cultivar type had a significant effect on the leaf area of maize plants at 15 and 60 days after planting (DAP) (Table 3). At 15 DAP, the use of the ADV Jago cultivar combined with 100% inorganic fertilizer + without biofertilizer (P1), 75% inorganic fertilizer + 5 ml biofertilizer (P5), and 100% inorganic fertilizer + 10 ml biofertilizer (P7) resulted in a higher leaf area compared to other treatments. However, the effect was not significantly different from the Hibrida P35 cultivar, which was treated with 75% inorganic fertilizer + 5 ml biofertilizer (P5) and 100% inorganic fertilizer + 10 ml biofertilizer (P7). At 60 DAP, the ADV Jago cultivar combined with 100% inorganic fertilizer + 10 ml biofertilizer (P7) produced the highest leaf area among all treatments. These results indicate that the appropriate combination of biofertilizer and inorganic fertilizer doses can significantly increase the leaf area of maize plants, positively impacting the plant's production potential. The size of the leaf area in maize plants is influenced by biofertilizers, which enhance nitrogen availability through nitrogen-fixing bacteria. The nitrogen nutrient is utilized by the plants to form proteins; as the amount of protein produced increases, the amount of protoplasm within plant cells will also increase, subsequently leading to an increase in leaf length, width, area, and quantity (Fahrindra et al., 2024).

Different results were observed at the ages of 30 and 45 days after planting (DAP), where no interaction between the combination treatment of biofertilizer and inorganic fertilizer doses and cultivar type was found regarding the leaf area of maize plants (Table 4). The use of the ADV Jago cultivar resulted in a higher leaf area compared to the Hibrida P35 cultivar at 30 DAP. This aligns with the statement by Dewi et al. (2023) that each variety possesses distinct genetic traits, which can determine growth, production, and the plant's ability to adapt to its environment. The application of 100% inorganic fertilizer + 10 ml biofertilizer (P7) significantly increased the leaf area of maize plants to 1732.56 cm² at 30 DAP and 8618.25 cm² at 45 DAP. Leaf area is a quantitative measure of plant growth and can determine the amount of sunlight received. The amount of sunlight received and the rate of photosynthesis depend on the existing leaf area. By applying N, P, K fertilizers and biofertilizer to improve soil fertility, the chemical properties of the soil become favorable, enhancing the absorption of nutrients and water from the soil, which in turn positively influences the photosynthesis process. An increased leaf area with a higher chlorophyll content allows for a more effective photosynthesis process, leading to greater accumulation of photosynthates in the dry weight of the plant (Lihiang & Lumingkewas, 2020; Zulfita et al., 2024).

The use of lower doses of inorganic fertilizer, specifically 75% and 50%, combined with the addition of biofertilizer, either 5 ml or 10 ml, resulted in a leaf area that was not significantly different from the treatment with 100% inorganic fertilizer at 30 DAP. However, at 45 DAP, the treatment of 50% inorganic fertilizer + 10 ml biofertilizer (P9) produced a leaf area that was not significantly different from the treatment with 100% inorganic fertilizer. These results indicate that biofertilizers can substitute the nutrient requirements of maize plants for inorganic fertilizers, thereby reducing the extensive use of inorganic fertilizers. According to Prayogo et al. (2021), biological fertilizers and NPK fertilizers can increase leaf area and reduce the excessive dose of inorganic NPK fertilizers. Fertilizers containing nitrogen play an active role as one of the most crucial elements needed for plant growth, particularly for leaf area development. Beneficial soil microbes, in this case, nitrogen-fixing bacteria and phosphate-solubilizing bacteria, play an essential role in promoting plant growth and yield. Microbial inoculants represent an alternative approach to reduce the reliance on chemical fertilizers (Fitriatin et al., 2021).

Plant Growth Rate

The average growth rate of plants is a calculation used to assess the rate of biomass increase in plants at various ages over a specified area. The research findings indicate that the interaction between the combination treatment of biofertilizer and inorganic fertilizer doses and the cultivar type has a significant effect on the growth rate of maize plants at different observation ages (Table 5).

During the growth period from 15 to 30 days after planting (DAP), the use of the ADV Jago cultivar combined with 100% inorganic fertilizer + 5 ml biofertilizer (P5) or 100% inorganic fertilizer + 10 ml biofertilizer (P7) resulted in the highest growth rates compared to all other treatments. In the growth period from 30 to 45 DAP, both the ADV Jago and Hibrida P35 cultivars, when supplemented with 75% inorganic fertilizer + 10 ml biofertilizer (P8), exhibited growth rates that were comparable to those of the 100% inorganic fertilizer treatment (P1) for both maize cultivars. From 45 to 60 DAP, the ADV Jago cultivar combined with 100% inorganic fertilizer + 10 ml biofertilizer (P7) produced the highest growth rate compared to all other treatments.

These results demonstrate that the efficiency of nutrient utilization for biomass formation is influenced by the selection of the appropriate cultivar, accompanied by the correct fertilization composition. This is consistent with the findings of Ananda et al. (2022), which show that different maize cultivars and biofertilizers result in varying growth rates. Plants with relatively higher growth rates have a greater opportunity to acquire resources compared to those with slower growth rates (Boni et al., 2020).

Table 1. Stem diameter of maize plants as a result of the interaction between the combination of biofertilizer and inorganic fertilizer doses and cultivar type at 15 days after planting (DAP)

Combination of biofertilizer and inorganic fertilizer doses	Stem diameter of maize plants (cm)			
	ADV Jago (K1)		Hibrida P35 (K2)	
Anorganic fertilizer 100% + no biofertilizer (P1)	0,77	ef	0,47	abcde
Anorganic fertilizer 75% + no biofertilizer (P2)	0,40	abcd	0,33	ab
Anorganic fertilizer 50% + no biofertilizer (P3)	0,53	abcde	0,37	abc
Anorganic fertilizer 100% + biofertilizer 5 ml (P4)	0,93	fg	0,23	a
Anorganic fertilizer 75% + biofertilizer 5 ml (P5)	0,47	abcde	0,23	a
Anorganic fertilizer 50% + biofertilizer 5 ml (P6)	0,40	abcd	0,73	def
Anorganic fertilizer 100% + biofertilizer 10 ml (P7)	0,97	fg	1,23	g
Anorganic fertilizer 75% + biofertilizer 10 ml (P8)	0,63	bcdef	0,70	cdef
Anorganic fertilizer 50% + biofertilizer 10 ml (P9)	0,57	abcde	0,73	def
LSD 5%	0,33			

Note: Values followed by the same letters indicate no significant differences as determined by the Least Significant Difference (LSD) test at a 5% significance level (p = 0.05); ns = not significant.

Table 2. Stem diameter of maize plants (cm) as a result of the treatment combination of biofertilizer and inorganic fertilizer doses and cultivar type at various plant ages (days after planting, DAP).

Treatment	Stem diameter of maize plants (cm) at various plant ages (days after planting, DAP)					
	30		45		60	
Combination Of Biofertilizer Doses+ Anorganic Fertilizer						
Anorganic Fertilizer 100% + No Biofertilizer (P1)	1,25	cd	2,30	b	2,85	bc
Anorganic Fertilizer 75% + Without Biofertilizer (P2)	0,73	a	1,07	a	2,75	b
Anorganic Fertilizer 50% + No Biofertilizer (P3)	0,82	ab	1,25	a	2,28	a
Anorganic Fertilizer 100% + Biofertilizer 5 Ml (P4)	1,83	e	2,62	bc	3,00	bc
Anorganic Fertilizer 75% + Biofertilizer 5 Ml (P5)	0,65	a	1,08	a	2,75	b
Anorganic Fertilizer 50% + Biofertilizer 5 Ml (P6)	0,67	a	1,13	a	2,72	b
Anorganic Fertilizer 100% + Biofertilizer 10 Ml (P7)	1,83	e	2,87	c	3,15	c
Anorganic Fertilizer 75% + Biofertilizer 10 Ml (P8)	1,58	de	2,57	bc	2,88	bc
Anorganic Fertilizer 50% + Biofertilizer 10 Ml (P9)	1,12	bc	2,17	b	2,80	bc
LSD 5%	0,33		0,46		0,36	
Maize cultivar						
ADV Jago (K1)	1,24		1,94		2,82	
Hibrida P35 (K2)	1,09		1,85		2,78	
LSD 5%	tn		tn		tn	

Note: Values followed by the same letters indicate no significant differences as determined by the Least Significant Difference (LSD) test at a 5% significance level (p = 0.05); ns = not significant.

Table 3. Leaf Area (cm²) of maize plants as a result of the combination treatment of biofertilizer and inorganic fertilizer doses and cultivar type at 15 and 60 DAP

Combination of biofertilizer doses and anorganic fertilizer	15 DAP (day after planting)				60 DAP			
	ADV Jago (K1)		Hibrida P35 (K2)		ADV Jago (K1)		Hibrida P35 (K2)	
Anorganic fertilizer 100% + no biofertilizer (P1)	218,38	g	86,00	bcde	10573,50	ef	9089,13	de
Anorganic fertilizer 75% + no biofertilizer (P2)	31,19	ab	33,30	ab	6952,50	bc	4021,88	a
Anorganic fertilizer 50% + no biofertilizer (P3)	42,25	abc	11,90	a	5578,88	ab	3937,50	a
Anorganic fertilizer 100% + biofertilizer 5 ml (P4)	143,06	ef	210,00	fg	10557,00	ef	7127,25	bcd
Anorganic fertilizer 75% + biofertilizer 5 ml (P5)	216,00	g	128,00	de	10416,75	ef	4725,00	a
Anorganic fertilizer 50% + biofertilizer 5 ml (P6)	65,50	abcd	106,13	cde	9399,30	e	4443,75	a
Anorganic fertilizer 100% + biofertilizer 10 ml (P7)	230,25	g	213,00	fg	15427,50	h	12540,00	fg
Anorganic fertilizer 75% + biofertilizer 10 ml (P8)	29,00	ab	18,20	ab	12960,00	g	8740,00	cde
Anorganic fertilizer 50% + biofertilizer 10 ml (P9)	33,90	abc	22,63	ab	9870,75	e	4005,20	a
LSD 5%	51,21				2126,83			

Note: Values followed by the same letters indicate no significant differences as determined by the Least Significant Difference (LSD) test at a 5% significance level (p = 0.05); ns = not significant.

Table 4. Leaf Area (cm²) of maize plants as a result of the combination treatment of biofertilizer and inorganic fertilizer doses and cultivar type at 30 and 45 DAP

Treatment	Leaf area of maize plants (cm²) at various plant ages (days after planting, DAP)			
	30		45	
Combination Of Biofertilizer Doses+ Anorganic Fertilizer				
Anorganic Fertilizer 100% + No Biofertilizer (P1)	1181,25	c	5816,25	d
Anorganic Fertilizer 75% + No Biofertilizer (P2)	200,19	a	1052,5	a
Anorganic Fertilizer 50% + No Biofertilizer (P3)	193,00	a	868,17	a
Anorganic Fertilizer 100% + Biofertilizer 5 Ml (P4)	1237,50	c	6582,33	e
Anorganic Fertilizer 75% + Biofertilizer 5 Ml (P5)	1320,38	c	4191,00	c
Anorganic Fertilizer 50% + Biofertilizer 5 Ml (P6)	648,75	b	2138,33	b
Anorganic Fertilizer 100% + Biofertilizer 10 Ml (P7)	1732,56	d	8618,25	f
Anorganic Fertilizer 75% + Biofertilizer 10 Ml (P8)	1193,50	c	6987,08	e
Anorganic Fertilizer 50% + Biofertilizer 10 Ml (P9)	1173,63	c	5655,5	d
LSD 5%	349,93		708,94	
Maize Cultivar				
ADV Jago (K1)	856,01	b	5672,85	
Hibrida P35 (K2)	673,04	a	5496,13	
LSD 5%	164,96		tn	

Note: Values followed by the same letters indicate no significant differences as determined by the Least Significant Difference (LSD) test at a 5% significance level (p = 0.05); ns = not significant.

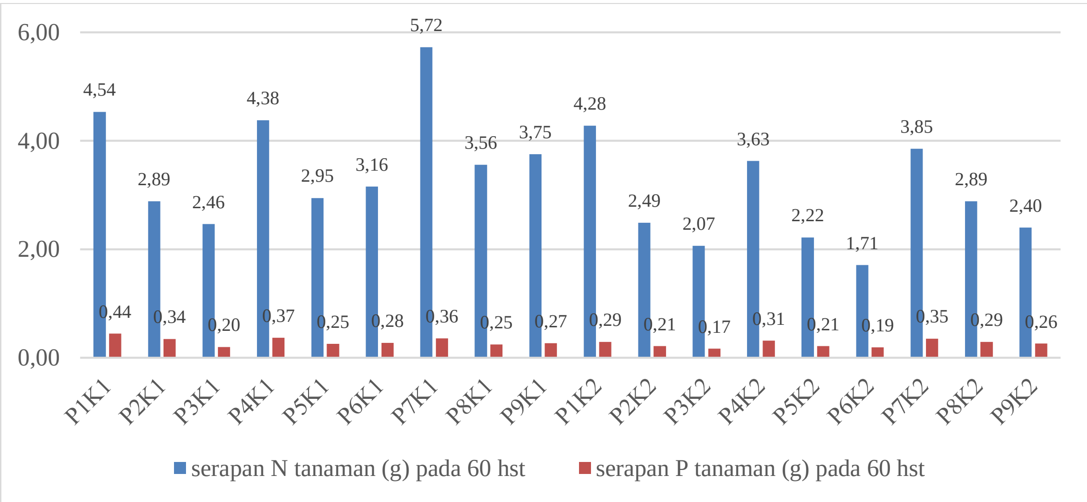

Figure 1. Nutrient uptake of nitrogen and phosphorus by maize plants at 60 days after planting (DAP).

Nutrient Uptake of Nitrogen and Phosphorus by Plants

The application of a combination of biofertilizer and inorganic fertilizer doses on two maize cultivars resulted in varying nitrogen and phosphorus nutrient uptake at the observation age of 60 days after planting (DAP). Figure 1 illustrates that the highest nitrogen uptake was observed in the treatment of 100% inorganic fertilizer + 10 ml biofertilizer (P7) for the ADV Jago cultivar (K1). The addition of biofertilizer to the soil can enhance the development of microorganisms within the soil. One role of biofertilizers is to serve as a habitat for beneficial microorganisms. The increase in microbial population due to the addition of biofertilizers containing nitrogen-fixing bacteria can enhance soil nitrogen levels, leading to higher nitrogen uptake by the plants. Elevated nitrogen uptake can improve photosynthesis rates and enhance plant growth (Fitriatin et al., 2021; Maknuna & Soeparjono, 2023).

The highest phosphorus uptake was found in the treatment of 100% inorganic fertilizer + without biofertilizer (P1) for the ADV Jago cultivar (K1), while the lowest phosphorus uptake was recorded in the treatment of 50% inorganic fertilizer + without biofertilizer (P3) for the Hibrida P35 cultivar (K2) (Figure 1). Moreover, the application of biofertilizer to the ADV Jago cultivar resulted in an average phosphorus uptake that was higher compared to the treatment with 50% inorganic fertilizer without biofertilizer. This indicates that plant phosphorus uptake is influenced by the availability of phosphorus in the soil. This finding aligns with the research conducted by Lovitna et al. (2021), which states that the combination of phosphate-solubilizing bacteria and inorganic fertilizers containing high phosphate levels enhances phosphorus availability in Alfisol soil. Phosphorus fertilization becomes a solution for providing phosphorus in an available form, thereby influencing maize production (Ishaq et al., 2024).

CONCLUSION

The ADV Jago cultivar, combined with 100% inorganic fertilizer and 10 ml of biofertilizer (P7), showed optimal maize growth, particularly in leaf area at 60 days after planting (DAP) and growth rate between 45 and 60 DAP. The Hibrida P35 cultivar improved stem diameter at 15 DAP under the same treatment. Lower doses of inorganic fertilizer (75% and 50%) with biofertilizer yielded similar results, suggesting biofertilizer can partially substitute for inorganic fertilizer.

Table 5. Plant growth rate resulting from the interaction of biofertilizer and inorganic fertilizer dose combinations and cultivar types across various growth stages

Combination of biofertilizer doses dan anorganic fertilizer	Growth Rate of Maize Plant (g m^{-2} $minggu^{-1}$) at various growth stages			
	ADV Jago (K1)		Hibrida P35 (K2)	
	ages 15 – 30 hst			
Anorganic fertilizer 100% + no biofertilizer (P1)	23,190	gh	19,750	efg
Anorganic fertilizer 75% + no biofertilizer (P2)	17,250	cde	6,810	a
Anorganic fertilizer 50% + no biofertilizer (P3)	13,929	bc	5,440	a
Anorganic fertilizer 100% + biofertilizer 5 ml (P4)	27,179	i	21,214	fgh
Anorganic fertilizer 75% + biofertilizer 5 ml (P5)	16,429	cde	10,940	b
Anorganic fertilizer 50% + biofertilizer 5 ml (P6)	16,714	cde	7,417	a
Anorganic fertilizer 100% + biofertilizer 10 ml (P7)	28,833	i	23,417	h
Anorganic fertilizer 75% + biofertilizer 10 ml (P8)	18,833	ef	17,571	de
Anorganic fertilizer 50% + biofertilizer 10 ml (P9)	17,869	def	15,071	cd
LSD 5%	3,49			
	observation age 30 – 45 hst			
Anorganic fertilizer 100% + no biofertilizer (P1)	257,02	cdef	224,881	cdef
Anorganic fertilizer 75% + no biofertilizer (P2)	203,33	abc	210,000	bcde
Anorganic fertilizer 50% + no biofertilizer (P3)	155,24	ab	152,143	a
Anorganic fertilizer 100% + biofertilizer 5 ml (P4)	258,57	def	259,762	def
Anorganic fertilizer 75% + biofertilizer 5 ml (P5)	205,48	abcd	268,929	f
Anorganic fertilizer 50% + biofertilizer 5 ml (P6)	155,36	ab	223,214	cdef
Anorganic fertilizer 100% + biofertilizer 10 ml (P7)	262,38	f	268,214	f
Anorganic fertilizer 75% + biofertilizer 10 ml (P8)	265,36	f	263,333	ef
Anorganic fertilizer 50% + biofertilizer 10 ml (P9)	251,43	cdef	157,381	ab
LSD 5%	55,08			
	observation age 45 – 60 hst			
Anorganic fertilizer 100% + no biofertilizer (P1)	199,187	ef	175,020	de
Anorganic fertilizer 75% + no biofertilizer (P2)	189,111	def	27,619	a
Anorganic fertilizer 50% + no biofertilizer (P3)	184,651	def	62,952	ab
Anorganic fertilizer 100% + biofertilizer 5 ml (P4)	263,333	fg	164,540	cde
Anorganic fertilizer 75% + biofertilizer 5 ml (P5)	139,992	bcde	71,655	ab
Anorganic fertilizer 50% + biofertilizer 5 ml (P6)	191,988	ef	61,060	ab
Anorganic fertilizer 100% + biofertilizer 10 ml (P7)	289,556	g	191,750	def
Anorganic fertilizer 75% + biofertilizer 10 ml (P8)	115,774	bcd	93,397	abc
Anorganic fertilizer 50% + biofertilizer 10 ml (P9)	112,810	bcd	158,056	cde
LSD 5%	78,96			

Note: Values followed by the same letters indicate no significant differences as determined by the Least Significant Difference (LSD) test at a 5% significance level (p = 0.05); ns = not significant.

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AUTHORS CONTRIBUTIONS

DASH and AIY considered and planned the experiment. DASH and AIY collected data and also performed analysis data. AIY interpreting the data. DASH prepared the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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