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1. Judul awal saat submission adalah :

Research Articles

The Impact of Organic Fertilizer on the Growth, Rhizome Yield, and Secondary Metabolite Levels of Bangle Plant (Zingiber montanum)

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Abstract

Riwavat artikel: Indonesia is a major producer of spices in the world. Bangle is one of the traditional medicines that some people have heard has beneficial effects on the body. Although the bangle has a lot to offer in terms of content and Diterbitkan advantages, there is still a huge gap in market demand, which is caused by the cultivation method's shortcomings. One way to boost the bangle plant's Kata kunci: productivity is to provide manure. The goal of this study was to establish the ideal manure dosage for bangle plant growth, rhizome yield, and secondary metabolic antioxidant content. The study employed a Randomized Block kemiringan lahan Design (RAK), with one treatment consisting of organic fertilizer in the form pengolahan tanah of cow and chicken manure, and the levels were divided into seven, namely pertumbuhan P0 (control), P1 (cow manure 20 tons/ha), P2 (cow manure 40 tons/ha), P3 (cow manure 60 tons/ha), P4 (chicken manure 20 tons/ha), P5 (40 tons/ha of chicken manure), and P6 (60 tons/ha of chicken manure), and then repeat four times. Data analysis in the form of qualitative and quantitative data. DMRT level 5% is further tested quantitatively using analysis of variance, while qualitative data is collected using the descriptive method. The study's findings

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indicate that a cow manure dose of 60 tons/ha is the best dose for plant growth, as measured by an average height increase of 42.78 cm, an increase in the number of leaves (116.65 pieces), and an increase in the number of tillers (14.45 pieces) at 18 weeks after planting. A dose of 60 tons/ha of chicken manure produced the best root length of 41.03 cm. The highest dry and wet weight yields, of about 179.75 g and 822 g, respectively, came from the rhizome weight of cow manure at a dose of 60 tons/ha. The highest secondary metabolic levels in each parameter are found in dry rhizomes (phenolic 202.79mg/L, flavonoid 181.91mg/L, and tannin 5406.33mg/L), and wet rhizomes (phenolic 178.56mg/L, flavonoid 104.39mg/L) with the highest tannin compound at around 4144.83mg/L in chicken manure dose of 40 tons/ha resulted in very strong antioxidant results in each of the wet and dry rhizomes, which were respectively 9.52 ppm and 8.06 ppm.

Keywords: organic fertilizer, bangle, secondary metabolism

Mengutip artikel ini: Palupi, NP., Kesumaningwati, R., Subeki, Mujiono, K., Sofian, Paramita, S dan Arung, ET., 2022. Pengaruh perlakuan tingkat kemiringan lahan dan pengolahan tanah terhadap pertumbuhan dan hasil tanaman bangle (*Zingiber montanum*). Journal of Degraded and Mining Lands Management.

Introduction

One of the biggest producers of spices worldwide is Indonesia. Bangle is a traditional medicine that some people believe has beneficial properties for the body. Bangle (Zingiber montanum), a Zingiberaceae family member, has long been used in traditional medicine (Noviyanto et al., 2020). Bangle rhizome is aromatic, which distinguishes it from other Zingiberaceae family members. Bangle, in its physical form, is similar to other spices in the Zingiberaceae family (Fernandarisky et al., 2020). The bangle is rich in saponins, flavonoids, phenolic compounds, essential oils, tannins, steroids, triterpenoids, antioxidants, vitamin C, vitamin E, and carotene. According to research, Bangle rhizome extract has pharmacological activity as an antibacterial, laxative, pancreatic lipase inhibitor, and protects cells from oxidative stress caused by H_2O_2 (Noviyanto et al., 2020).

Due to insufficient fertilization, pest control, soil management, and other cultivation techniques, bangle rhizome production frequently experiences a significant gap between the maximum and minimum yields or is said to frequently experience erratic fluctuations in yields. there aren't enough references on growing this plant. Bangle cultivation can yield fresh rhizomes weighing 10-20 tons per acre (Evizal, 2013). One very important cultivation technique is fertilization.

Other than its primary function as a stem, the rhizome may serve other purposes, the most

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common of which is to serve as a storage site for certain metabolism (metabolic) products. Metabolic products can be used as drugs in some cases, but their content is sometimes uncertain and tends to be lower. Temperature, nutrition, water availability, and CO2 levels in the atmosphere are all factors that can influence secondary metabolic levels (Amelia, 2015). The availability of complete and balanced nutrients that can be absorbed by plants is a factor that influences plant growth and production (Dewanto et al., 2017)

Giving the bangle plant organic fertilizer is one way to boost its own productivity. Organic fertilizers can be in the form of solid or liquid fertilizers made from dead plants, animal dung, animal parts, or other organic wastes that have undergone an engineering process. They can also be enriched with microorganisms or minerals (Permentan, 2011). Manure is one of the most commonly used organic fertilizers. Manure is processed livestock manure that is applied to agricultural land in order to improve soil fertility and structure. The nutrients in manure vary depending on the source.

According to Hartatik (2015), cow manure contains N (6 kg/ton), P (1.5 kg/ton), K (3 kg/ton), Ca (1.2 kg/ton), Mg (1 kg/ton), and S (0.9 kg/ton). Chicken manure itself contains N (15 kg/ton), P (7 kg/ton), K (8.9 kg/ton), Ca (3 kg/ton), Mg (8.8 kg/ton) and S (0.3 kg/ton). Animal manure contains a lot of nitrogen as well as metallic minerals like magnesium, potassium, and calcium. The primary benefit of manure is that it preserves the physical structure of the soil, allowing roots to grow properly, as well as supporting the biological and chemical properties of the soil (Melsasail et al., 2019). Therefore, the purpose of fertilization is to replenish lost nutrients and increase the amount of nutrients available to plants, thereby increasing plant quality and quantity.

Method

Place and Time

The study was conducted from September 2021 to March 2022, lasting about 5 months. The research location was in the experimental garden of Mulawarman University Teluk Dalam, L2, Tenggarong Sebrang, East Kalimantan. The second place is in the Laboratory of Post-Harvest and Packaging of Agricultural Products, Faculty of Agriculture, Mulawarman University.

Research Design

The study was designed using a Randomized Block Design (RAK), with one treatment using organic fertilizer in the form of cow and chicken manure. The levels were then divided into 7 groups, with P0, P1, P2, P3, P4, P5, and P6 each receiving a different dose of each type of manure. The treatment was then repeated four times.

- The following dosages are used:
- P₀: Control (without fertilizer)
- P₁: 20 ton/ha of cow manure
- P2: 40 ton/ha of cow manure
- P3: 60 ton/ha of cow manure
- P4: 20 ton/ha of chicken manure
- P5: 40 ton/ha of chicken manure
- P₆: 60 ton/ha of chicken manure

The plot has a length of 6 m and a width of 1 m. Planting one seed per planting hole results in a spacing of approximately 50 x 100 cm. To prevent waterlogging and seedling rot, seedlings are planted in ditches with good drainage. In order to facilitate landfilling later, planting is done in the trench.

Data Analysis

Observed data include: an increase in plant height; an increase in the number of leaves; an increase in the number of tillers; an increase in root length; an increase in the wet and dry weights of rhizomes; and an increase in secondary metabolic and antioxidant levels. Data will be collected every three weeks at 3, 6, 9, 12, 15, and 18 MST for height, additional number of leaves, and number of tillers. After the plants were harvested, wet weight, dry weight, root length, secondary metabolic, and antioxidant levels were measured. The analysis of variance (ANOVA) was used with a 5% confidence level. If the variance is obtained and the results show that each treatment in each group is significantly different from each other, a 5% level DMRT test will be performed.

The results of the secondary metabolic level identification and antioxidant activity tests were analyzed qualitatively using descriptive methods. Comparing phytochemical compound levels in each treatment based on secondary metabolism levels. Antioxidant activity is assessed by comparing the IC50 values in each treatment. We used spectrophotometry methode for all of paramater of secondary metabolic level test.

Results and Discussion

Result

According to the results of an analysis of variance with an ANOVA table at the 5% level, the treatment of giving organic fertilizer in the form of chicken and cow manure is significantly different for height increase, number of tillers, the number of leaves increased, root length, wet weight of rhizomes, and dry weight of plant rhizomes. Only root length was affected significantly.

Plant growth

Table (1) shows that when the plant is about 6 weeks old, a cow manure dose of 60 tons/ha produces the best results (on average about 26.16 cm), followed by chicken manure doses of 60 tons/ha, chicken 40 tons/ha, and cattle 40 tons/ha. In comparison to the previous week, the plant's age 9 weeks after planting showed a very rapid increase in plant height. At 9 mst, the best dose was 40 tons/ha of chicken manure with an average addition of about 32.45 cm. The best results were obtained at week 12, with a cow manure dose of 60 tons/ha yielding an average yield of 37.24 cm. Cow manure at 20 tons/ha and chicken manure at 20 tons/ha did not produce significantly different results than the control. The best dose at week 15 after planting was 60 tons/ha of cow manure, with an average depth of 40.47 cm, and 38.38 cm of chicken manure. Cow manure provided the highest dose, with an average of 42.78 cm at week 18 after planting.

Number of Tillers

Table (2) shows that the highest number of tillers were found at a dose of 60 tons/ha of chicken manure, with an average of 1.65 at 6 weeks after planting. At the age of 9 mst, a control with an average tiller of about 2.55 produced results that were not significantly different from chicken manure 20 tons/ha. The best application this week is 60 tons/ha of cow manure with an average of 4.15 tillers. At 12 mst, the effect of manure treatment revealed that the best dose was 40 tons/ha chicken manure, with an average of 6.65. This best dose did not differ significantly

between chickens and cows manure at 60 tons/ha or chickens manure at 20 tons/ha. Cow and chicken manure at a dose of 60 tons/ha at 15 mst produced the highest yields, with cow yields of 9.50 and chicken yields of 9.00, respectively. At 18 weeks, the control did not differ significantly from the cow manure doses of 20 and 40 tons/ha. The highest dose was in cow manure at 60 tons/ha with an average of 14.45 tillers and chicken manure at 60 tons/ha with an average of 13.37 tillers.

Number of Leaves

Table (3) shows that after 6 weeks of treatment with a dose of 20 tons/ha of chicken manure, the results were not statistically significantly different from the control but significantly different from those other than the control. The best dose of cow manure, 60 tons/ha, was produced at 9 weeks of turbidity, with an average increase in the number of leaves of 37.95 strands. At 12 weeks, the control showed no significant difference from cow manure 20 and 40 tons/ha, as well as chicken manure 20 and 40 tons/ha. Cow manure 60 tons/ha with an average of 52.80 strands provided the best dose at 12 mst. The highest dose was found in cow manure at a rate of 60 tons/ha in week 15, with an average of 84.55. Cow manure 60 tons/ha with an average of 116.65 strands in the 18th week produced the best results with a significant difference from the control, but chicken manure 60 tons/ha with an average increase in the number of leaves 105.80.

Root length wet weight and Rhizome dry weight

Table (4) shows that the lowest yield in cow manure is 20 tons/ha with an average root length of 24.36 cm. The control yielded results that were not statistically different from cow and chicken manure at 20 tons/ha, as well as the highest dose. This result indicates that applying different doses of manure had no effect on the root length of the bangle plant in all treatments.

The chicken manure 20 tons/ha dosage of bangle rhizome had the lowest wet weight, with an average weight of 392.35g. While the control yielded results that were not significantly different from 20 tons/ha of cow and chicken manure as well as 40 tons/ha of chicken and cattle, the results from 40 tons/ha of chicken and cows also did not differ significantly from those from 60 tons/ha of chicken manure. Ha. Cow manure yielded the highest yield of 60 tons/ha with an average wet weight of rhizome of 822.00g and produced statistically significant differences for all treatments.

The lowest dry weight of bangle rhizome was shown by cow and chicken manure at a dose of 20 tons/ha, respectively 86.00g of cow manure and 78.25g of chicken manure. This result showed a lower weight compared to the control, with an average of 93.75g. The control yielded statistically insignificantly different results than chicken manure 20 and 40 tons/ha, cattle 20 and 40 tons/ha, and chicken 60 tons/ha, but yielded significantly different results than the best dose. The best dose is 60 tons/ha of cow manure with an average dry weight of 179.75g of rhizomes, followed by 60 tons/ha of chicken manure with an average of 135.75g

Table 1. Effect of Cow and Chicken Manure on Rhizome Height (in cm).

Manure Treatment	Weeks after Planting (MST)					
(ton/ha)	6	9	12	15	18	
Control	11,38 a	18,61 a	24,68 a	20,41 a	18,82 a	
Cow 20 ton/ha	17,46 b	20,26 ab	25,44 a	24,02 ab	28,51 b	
Cow 40 ton/ha	20,51 c	27,95 b	29,81 ab	35,57 cd	37,19 c	
Cow 60 ton/ha	26,16 e	31,18 b	37,24 c	40,47 d	42,78 c	
Chicken 20 ton/ha	17,36 b	27,21 b	30,16 abc	29,15 bc	28,82 b	
Chicken 40 ton/ha	22,84 cd	32,45 b	34,83 bc	37,61 cd	36,37 c	
Chicken 60 ton/ha	25,68 de	32,17 b	36,84 bc	38,38 d	39,22 c	

Table 2. Effect of Cow and Chicken Manure on Rhizome number of tillers (in weeks)

Manure Treatment	-	_			
(ton/ha)	6	9	12	15	18
Control	0,8 a	2,55 a	3,95 a	5,80 a	8,60 a
Cow 20 ton/ha	0,7 b	3,45 b	5,20 b	6,60 a	10,40 ab
Cow 40 ton/ha	1,7 ac	3,40 b	5,05 ab	7,35 ab	11,55 b
Cow 60 ton/ha	1,6 c	4,15 b	6,10 bc	9,50 c	14,45 d
Chicken 20 ton/ha	1,3 bc	3,35 ab	5,70 bc	7,40 ab	11,05 b
Chicken 40 ton/ha	1,5 c	4,00 b	6,65 c	8,45 bc	12,15 bc
Chicken 60 ton/ha	1,65 c	3,75 b	6,05 bc	9,00 c	13,70 cd

Table 3. Effect of Cow and Chicken Manure on number of Rhizome Leaves (in weeks)

Manure Treatment	Weeks after Planting (MST)				
(ton/ha)	6	9	12	15	18
Control	4,70 a	19,60 a	35,80 a	52,25 a	77,55 a
Cow 20 ton/ha	5,55 a	25,00 ab	41,05 ab	55,65 a	83,80 a
Cow 40 ton/ha	9,65 b	28,25 abc	42,70 abc	66,00 ab	95,35 ab
Cow 60 ton/ha	10,05 b	37,95 c	52,80 c	84,55 c	116,65 c
Chicken 20 ton/ha	9,20 b	26,00 ab	40,25 ab	56,85 a	81,75 a
Chicken 40 ton/ha	9,65 b	30,90 bc	43,25 abc	67,05 bc	91,35 ab
Chicken 60 ton/ha	11,05 b	30,45 abc	50,75 bc	79,55 bc	105,80 bc

Table 4. Effect of Cow and Chicken Manure on Root Length and Rhizome Weight (in 18 week)

Manure Treatment (ton/ha)	Root Length (cm)	Rhizome wet weight (g)	Rhizome dry weight (g)
Control	31,90 ab	415,25 ab	93,75 ab
Cow 20 ton/ha	24,36 a	444,75 ab	86,00 a
Cow 40 ton/ha	35,36 b	530,00 bc	119,00 ab
Cow 60 ton/ha	36,50 b	822,00 d	179,75 c
Chicken 20 ton/ha	33,20 ab	393,25 a	78,25 a
Chicken 40 ton/ha	38,95 b	487,50 abc	99,75 ab
Chicken 60 ton/ha	41,03 b	618,75 c	134,75 bc

Notes: Based on Duncan's multiple-distance further test (DMRT) at a 5% significance level, values in the same columns that are followed by the same letter do not differ significantly.

Table 5. Secondary Metabolic Levels in Bangle Rhizome in Each Treatment (mg/L).

a re		Level (mg/L)				
Condition	Treatment	Phenolic	Flavonoid	Tanin		
	Control	31,64	23,08	2034,83		
	Cow 20 ton/ha	43,18	41,55	2991,50		
	Cow 40 ton/ha	77,03	64,30	3151,50		
Fresh	Cow 60 ton/ha	86,90	71,14	3198,17		
	Chicken 20 ton/ha	97,67	74,79	4086,50		
	Chicken 40 ton/ha	107,54	78,71	4144,83		
	Chicken 60 ton/ha	178,56	104,39	3861,33		
	Control	124,97	38,44	1932,33		
	Cow 20 ton/ha	133,56	67,23	2504,00		
	Cow 40 ton/ha	148,44	68,76	3034,83		
Dry	Cow 60 ton/ha	181,38	99,43	4734,67		
	Chicken 20 ton/ha	en 20 ton/ha 175,23		4903,00		
	Chicken 40 ton/ha	198,69	156,10	5088,00		
	Chicken 60 ton/ha	202,79	181,91	5406,33		

Note: The number followed by yellow denotes the best outcome in each observation variable for the flavonoid test, tannin test, and phenolic test results.

Tabel 6. Antioxidant based on IC50 value

_	Fertilizer Dose ton/ha						
Antioxidant (IC50) (mg/L)	Control	Control		Chicken			
	control	20	40	60	20	40	60
Fresh Rhizome	53.58	48.55	47.36	47.14	32.73	27.42	9.52
Dry Rhizome	40.91	38.30	34.78	34.46	24.41	14.05	8.06

Note: The smaller the IC50 value, the stronger the antioxidant

Secondary metabolic level

In accordance with the findings of the secondary metabolism test, the rhizome of the bangle plant contained phenolic, flavonoid, and tannin-containing active substances, and also steroid, alkaloid, terpenoid qualitatively. Different levels of the compounds involved in this secondary metabolism are evident in each fertilizer application. The results are shown in table (5). Different concentrations were produced by the concentration of active substances in the bangle rhizome. The aforementioned data demonstrate that, despite using the same amount of fertilizer, the active compound content of the bangle rhizome is highest when the rhizome is dry (low moisture content) as opposed to when the rhizome is still fresh.

The amount of chicken manure that produces the highest phenolic content in the rhizome under wet and dry conditions, correspondingly around 178.56 mg/L and 202.79 mg/L, is 60 tons/ha. A dose of 60 tons/ha of chicken manure also provides higher levels of active flavonoids and tannins than other doses. When compared to the fertilizer treatment, the control had the lowest active **Discussion**

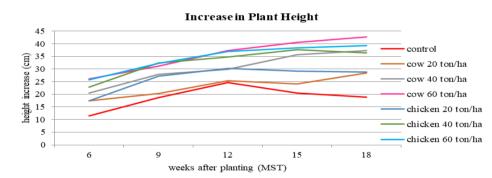
Plant Height

compound content. When treated with cow manure, yields are lower than when treated with chicken manure at the same dose.

Antioxidant

Antioxidant analysis of bangle rhizomes in table (6), using several samples based on manure dose and fresh and dry rhizome condition. IC_{50} value was obtained, which describes how well the sample can capture free radicals. The dose of 60 tons/ha of chicken manure was found to have the lowest IC_{50} value in the fresh sample, with a value of 9.52 ppm, while the control had the highest value, with an IC_{50} value of 53.58 ppm in fresh rhizome conditions.

The same quality was obtained when dry rhizome conditions were used for the analysis; specifically, the dose of 60 tons/ha of chicken manure produced the lowest IC_{50} value and the largest control. The plant's antioxidants are more potent the lower the IC_{50} value. Cow manure is always treated with an IC_{50} value higher than chicken manure.



According to the table 1, the average increase in plant height starting at 6,9,12,15, and 18 WAP produced mixed results that tended to fluctuate. At the age of 6 weeks, the treatment without fertilizer (control) continued to grow until week 12 when it reached its peak with an average height increase of about 24.68 cm, before adding less height the following week. In comparison to other treatments, the results from the fertilizer-free treatment had the lowest graph. In order for a plant to grow, nutrients must be obtained from the soil by the roots through their root hairs (Sudewi et al., 2022). Organic matter affects plant growth by influencing the physical, chemical, and biological properties of the soil (Anwar, 2013). The more organic matter provided, the faster the plant will grow. Compared to chicken manure, cow manure typically produces better results. According to

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(Hartatik et al., 2015) cow manure contains N (6 kg/ton), P (1.5 kg/ton), K (3.0 kg/ton), Ca (1.2 kg/ton), Mg (1.0 kg/ton), and S (0.9 kg/ton), and these nutrients can support the growth of Bangle plants, which have a long harvest period. Cow manure's graph tends to rise with each observation.

Chicken manure at all levels showed a significant increase at 9 weeks after planting, but at 12 weeks the increase in plant height slightly decreased in plant height. In chicken manure at a level of 20 tons/ha, the height increase was averaged at 30.16 cm after 12 weeks and decreased the following week. High nitrogen elements are found in chicken manure. Although the amount of nitrogen plants require is always higher than that of other nutrients, a deficiency or excess can hinder and disrupt plant growth (Raja et al., 2021). After planting, the growth rate of the bangle plant accelerated between 2 and 5 months. As plants get older, their growth rate for height starts to slow down (Rosita et al., 2005).

According to some research, applying chicken manure always results in the best plant response in the first growing season. This is because chicken manure decomposes relatively quickly and has enough nutrients compared to other manures of the same weight (Hartatik et al., 2015). The graph shows that chicken manure tends to increase quickly at 6, 9, and 12 weeks of age, then declines as plant age increases. Large-scale application of chicken manure is thought to be less effective because the nutrients will exhaust quickly.

The same result was also shown by chicken manure at a dose of 40 tons/ha which decreased the addition of plant height, the maximum height increase at this dose was at 15 weeks with an average height increase of 37.61 cm. When compared to the other two doses of chicken manure, the results for the 60 ton/ha level of chicken manure were a little bit different. A graph that increases over the course of 18 weeks can be used to demonstrate this, but the increase in plant height is typically not too different from the previous week. Even though cow manure at a dose of 40 tons/ha initially produced fewer yields than chicken manure at a dose of 40 tons/ha, at the end of the observation at 18 weeks the increase in height was more apparent and might even have exceeded that of chicken manure at a dose of 40 tons/ha, which caused a decrease in plant height.

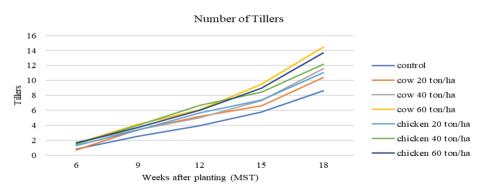
The addition of cow manure improves the physical properties of the soil. Improved soil physical

characteristics include things like increased permeability, total pore space, aggregate stability, volume weight, texture, color, temperature, and others (Sudewi et al., 2022). A dose of 60 tons/ha of chicken and cow manure has the tendency to produce steady, dependable results. Cow manure doses of 60 tons/ha tend to yield less than chicken manure doses of 40 and 60 tons/ha from the start of planting until the plant is 9 weeks old, but the yields increase the following week.

The plant's need for nutrients grows as it ages. If the nutrient requirements are not met and the nutrients are not readily available, plants may experience nutrient deficits at specific times. According to Rosita et al. (2005), bangle plants absorb N (0.06 - 3.07 g), P (0.01 - 0.53 g), and K at 2 to 10 months after planting in the canopy (0.10 to 2.25 g). N is the nutrient that is most required in the plant canopy itself. The primary nutrient for plants, nitrogen, is typically essential for the development and expansion of vegetative parts of plants, such as leaves, stems, and roots (Purba et al., 2021). A sufficient supply of plant N is indicated by high photosynthetic activity, good vegetative growth, and dark green plant colors (Nurhayati, 2021).

Due to the individual characteristics of each animal, which are influenced by the type of feed and the animal's age, each manure contains a different mix of nutrients (Nurjanah et al., 2020). Because each treatment dose of fertilizer has a different nutrient content, they all produce different yields and have different recommended doses. Due to their movement with crop yields, surface runoff, erosion, or evaporation, nutrients in the soil will gradually decrease over time (Lawenga et al., 2015).

Number of Tillers



The table of the total number of tillers from each level reveals results that increase with plant aging and are influenced by the quantity of fertilizer applied, as shown in the figure below. Plants without fertilizer developed more tillers every week, but the growth was typically modest. This slight increase resulted from the fact that during the initial stages of planting, the products of photosynthesis were utilized for the vegetative development of plants.

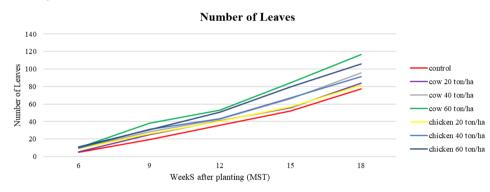
In comparison to manure application, treatment without fertilizer produced the lowest yield. The graph above makes it easy to see that there was a noticeable increase

at plants that were 18 WAP of age. A plant needs nutrients for its physiological processes during growth and development. Plant growth and production will be subpar due to a lack of nutrients (Purba et al., 2021).

Functions of organic matter as a biological buffer so that the soil can supply plants with a balanced amount of nutrients (Hartatik et al., 2015). Loosening the topsoil, increasing water absorption and storage, and boosting soil fertility are all important functions of manure (Yulianto et al., 2021). A sudden rise in the number of tillers can result from the ease with which new shoots can emerge from loose, moist soil.

At the start of planting, there were typically fewer and nearly identical numbers of tillers in each treatment. The nutrients in this fertilizer are not readily available to plants, which is the cause of the slow plant growth at the *Number of Leaves* start of the planting period. The extent of these materials' mineralization or decomposition has a significant impact on the nutrients' availability. Manure's low nutrient availability is partially caused by the presence of N, P, and other elements in complex compounds that are challenging to decompose (Hartatik et al., 2015).

At 6 mst, all treatments tended to be similar and the differences between the tillers in each treatment tended to be minimal. Although cow manure at a dose of 60 tons/ha is the best dose with an average number of tillers of 14.45 tillers, chicken manure typically produces better results than cow manure at the same dose. In comparison to other manure doses, chicken manure 40 tons/ha at 12 mst produced the best results with 6.65 tillers.



An increasing number of leaves are produced each week as a result of the weekly application of cow and chicken manure. The table 3 shows that at about 12 weeks of age, the number of leaves increases significantly. Every week, the increase varies depending on the treatment. The number of leaves significantly increased with a dose of 60 tons/ha of cow manure, averaging 15–37 leaves every three weeks. The number of similar-looking leaves tends to increase when manure is applied in the same amount. Both cow and chicken manure at a dose of 20 tons/ha and chicken and cow manure at a dose of 40 tons/ha produced nearly identical results during planting.

In addition to the nutrients that plant's needs, manure also contains humic, fulvic acids, growth hormones, and other substances that promote plant growth and increase nutrient uptake by plants (Hartatik et al., 2015). The amount of photosynthesis is influenced by the number of leaves present, and plants with more leaves may produce heavier and bigger rhizomes as a result.

The number of leaves added is also affected by the number of shoots and plant height. The number of leaves will increase as the plant ages and grows taller, produces more leaves on a single stem, and produces more tillers.

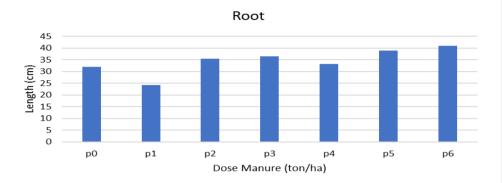
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The nutrients required for plant growth are present in sufficient amounts in manure. The related observation variables will be impacted by the food's growth quality and planting age.

In relation to the addition of the number of leaves, the most influential element is N. In comparison to other nutrients, nitrogen is required in sufficient amounts for plant growth. N makes up 40-50% of the dry weight of protoplasm, the living component of plants (Nurhayati, 2021). Since protein is the source of all plant enzymes, nitrogen participates in all enzymatic processes in plants. Additionally, nitrogen is one of the constituent elements of chlorophyll, the primary component of chloroplasts, and it contributes to improving the quality and quantity of the dry matter produced (Dr. Vladimir, 2021).

Fertilizer use and the amount of nutrients in the soil have a significant impact on how plants grow and develop. Nutrient uptake is restricted by nutrients in a minimum state (Purba et al., 2021). In terms of the addition of leaves, the treatment of plants without fertilizer differs significantly enough for each observation. In comparison to other treatments, plants without fertilizer produce the lowest yield.

Root Length



The results of the lowest root length were cow manure dose of 20 tons/ha with an average root length of about 24.36 cm and lower than the control. With an average root length of 41.03 cm, chicken manure had the longest roots. When plants respond to water shortages by reducing the rate of transpiration in order to conserve water, the roots play a crucial role (Torey et al., 2013). Plant roots have a significant impact on overall plant growth and development. The failure of the root function will result in a complete change in the plant for the top (Nurhayati, 2021).

Manure has the ability to bind water in the soil. Because the soil around the roots in the deeper layers is still moist, the roots will continue to grow. Maximizing exposure to groundwater will encourage the growth of roots (Torey et al., 2013). Plant roots directly respond to the physical characteristics of the soil (Lawenga et al., 2015).

The table's data, which was derived from root length in chicken manure, generally produces better results than cow manure. The use of this fertilizer can loosen the soil, increase aeration, and increase the soil's capacity to hold water, all of which can improve the physical properties of the soil (Raja et al., 2021). Additionally, organic matter has the ability to control soil temperature, slow down phosphorus fixation, increase soil cation exchange capacity, and lessen the leaching of nutrients like potassium, calcium, and magnesium (Guimarães et al., 2019). Another environmental factor that has been shown to affect the nitrate absorption process is the temperature around the roots (Dr. Vladimir, 2021).

The initial analysis of the soil revealed that the soil's pH ranged from 3.86 to 4.86. Al elements are common in excessively acidic soil, and they can poison plants and bind phosphorus (P). Low pH soil can hinder plant growth by preventing the roots from properly absorbing nutrients. Giving chicken manure up to 5-25 tons/ha, as demonstrated by Tufaill et al. (2014), shows that manure can raise the pH of soil from 5.0 to 5.8–6.4. By raising

pH, Al in exchangeable form will be reduced and nutrients will become more available to plants.

Nutrient uptake on the roots of bangle plants at 2-10 months after planting was as follows: N (0.01 - 0.52 g), P (0.002 - 0.15 g), and K (0.02 to 0.82 g) (Rosita et al., 2005). It was discovered that the roots of the bangle plant had more K buildup than N and P. K is primarily used to aid in the synthesis of proteins and carbohydrates. In the face of drought, illness, and pests, potassium gives plants strength (Purba et al., 2021). Organic fertilizers can help the soil's physical and chemical composition, which will facilitate root development. Up until the soil reaches its critical water potential, plant roots expand into moist soil and draw water (Solichatun et al., 2005). The looseness of the soil can promote root development. Strong roots will make it simpler for plants to absorb nutrients and water

Rhizome Wet Weight

Plant biomass is a common parameter used to study plant growth. The fresh weight of the plant describes the water and moisture content of the plant. The plant will weigh more when wet the more fertile it is (Supandi, 2021). When plant nutrient requirements are met, yields will be optimal (Purba et al., 2021). The rhizome of the bangle plant is the part that is most advantageous for cultivation. One could also argue that this rhizome's wet weight is a crucial factor in determining how well bangle plant cultivation is going. The cultivation method is better and more productive the more weight of the wet rhizome that can be obtained.

Rosita (2005) found that giving 250 kg/ha of urea, 250 kg/ha of SP36, 250 kg/ha of KCl, and 20 tons/ha of manure resulted in a fresh bangle rhizome weight of 311.39 g/plant 5 months after planting. According to the results of the application of organic fertilizers, at the age of 18 weeks, cow manure at a dose of 60 tons/ha produced the highest wet weight of rhizomes, averaging about 822

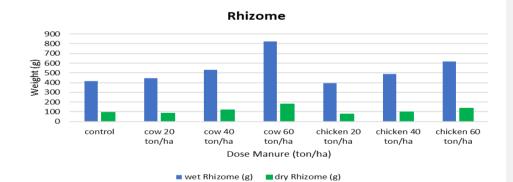
grams/plant, and chicken manure at a dose of 20 tons/ha produced the lowest wet weight of rhizomes, an average of 393.25 g/plant. Manure increases crop yield and quality while also enhancing the chemistry, physical characteristics, and biological properties of the soil (Seker et al., 2011). The graph below demonstrates that the yield of fresh rhizomes increases with increasing manure dosage.

Hasil It is impossible to separate the good physical qualities of the soil from the yield of this fairly large plant. The physical condition of the soil must support plant growth in addition to a supply of nutrients that is adequate and balanced (Lawenga et al., 2015). These soil aggregates will keep the soil in a loose condition (Anwar, 2013). Cow manure will enhance the physical characteristics of the soil. Improved soil physical characteristics include things like increased permeability, total pore space, aggregate stability, volume weight, texture, color, temperature, and others (Sudewi et al., 2022).

Intensive tillage affects the physical properties of the soil. Low organic matter soils will have more severe damage to the soil's structure (Anwar, 2013). When the soil does not receive enough water and becomes dense and hard, soil damage is evident. Plant rhizomes won't be able to grow or spread out in compacted or hard soil. The ability to maintain loose soil conditions that are difficult to harden or compact increases with the amount of organic matter added. Additionally, manure helps to improve soil structure, cation exchange capacity, and water resistance. Giving manure has the indirect effect of making it simpler to keep water in the soil (Yuliana et al., 2015). Since water availability plays a significant role in plant growth, water frequently restricts the growth and development of cultivated plants.

The plants will experience drought conditions if there is not enough water in the soil. Due to decreased primary metabolism, reduced leaf area, and decreased photosynthetic activity, drought stress can lower plant productivity (biomass). Smaller leaves grow as a result of a lack of water during the vegetative stage, which can reduce light absorption. Lack of water also inhibits the synthesis of chlorophyll and some enzymes, such as nitate reductase, from working (Solichatun et al., 2005).

Organic substances in the soil may have physiological effects on plant growth that are direct or indirect (Syaiful Anwar, 2013). Compared to other types of manure, chicken manure contains a fair amount of P. This is due to the fact that chicken manure contains feed (Sudewi et al., 2022). Phosphorus aids in the growth of plant roots, photosynthesis, transfer respiration, cell division, and growth (Supandi, 2021). The number of cells increases more quickly when they divide quickly, which causes the rhizome to grow larger.



Rhizome Dry Weight

The relationship between plant growth and the quantity and concentration of mineral nutrients in plant tissues is known as dry weight (Purba et al., 2021). Dry weight reflects plant nutritional status because it is affected by the rate of photosynthesis and respiration in each treatment. Based on the collected data, it was determined that applying chicken and cow manure at a dose of 20 tons/ha resulted in lower dry weight yields than the control. Additionally, the results from the 40 tons/ha manure dose were not significantly different from the control. Additionally, the results from the 40 tons/ha manure dose were not significantly different from the control. Many nutrients, such as N, P, and K, build up in the canopy when the bangle plant is between 2 and 7 BST, according to Rosita et al (2005). This is the active vegetative formation stage.

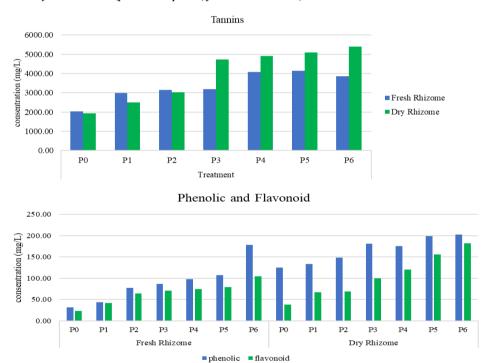
Cow manure at a dose of 60 tons/ha demonstrated different results and produced significantly better outcomes than other doses and types of manure. The

amount and timing of fertilizer applied can have an impact on crop yields, among other things. Organic matter plays a crucial role in soil health because it can create stable soil aggregates, increase soil fertility, and serve as a source of energy for organisms (Nurjanah et al., 2020).

Based on earlier studies on dry matter production and nutrient content in Bangle plant tissue, the N, P, and K amounts of nutrient uptake in dry rhizomes of Bangle plants aged 2 to 10 months were N (0.01 to 4.89 g), P (0.002 to 1, 04 g), and K (0.01 to 2.34 g), respectively (Rosita et al., 2005). It is clear that as plants get older, they are able to absorb an increasing amount of N, P, and K nutrients. As can be seen, N is the nutrient that has accumulated in the rhizome in the greatest amounts. The application of manure enhances the chemical, physical, and biological properties of the soil increase crop yield, and improves crop quality (Yolcu, Turan, et al., 2011). High organic matter soils have beneficial microorganisms that encourage the breakdown of organic matter and release inorganic nutrients that are then available for plant uptake (Seker, et al., 2011). Organic fertilizers can help to create ideal conditions in the soil for microorganisms that are beneficial to plants.

Chicken manure is an organic fertilizer with high nitrogen content, despite not being the best dose for bangle rhizome weight yield. As they ensure the best nutrient management for plants, such fertilizers should be used promptly to partially replace chemical fertilizers (Guimarães et al., 2019).

Secondary metabolic levels (phenolic compounds, flavonoids and tannins)



The results of laboratory analysis found that the positive bangle rhizome contains compounds in the form of phenolics, tannins and flavonoids. These findings are consistent with Amalia et al (2021), which found that the Bangle plant contains secondary metabolism in the form of alkaloids, phenolic compounds, flavonoids, saponins, and triterpenoids. These compounds respond differently to the concentration of organic fertilizer applied with cow and chicken manure. The graph above shows the outcomes of these phytochemicals.

According to the graph above, the amount of tannin compounds will increase as manure dosage rises. As can be seen, just like with chicken manure, cow manure with three doses of 20, 40, and 60 tons always increased the tannin concentration in the rhizome as the dose increased. When compared to cow manure, applying chicken manure produces significantly better results. It is evident that using 20 tons/ha (P4) of chicken manure instead of 60 tons/ha (P4) of cow manure resulted in a higher concentration (P3).

Dry rhizomes produced a higher concentration of tannins than fresh rhizomes, which produced different results regarding tannin concentration. The concentration of tannins in fresh rhizomes increased non-significantly with the addition of a dose of cow manure, whereas the concentration of tannin compounds in fresh rhizomes decreased with an increase in the dose of cow manure. In comparison to the use of manure in fresh and dry rhizomes, the control provided the lowest tannin concentration.

Tannins are chemical substances that have an astringent and bitter flavor. These substances act as controlling substances in plant metabolism as well as important defenses against herbivores and pests that prey on plants (Julianto, 2019). Tannins are metabolically active substances with multiple uses, including as astringents, antibacterial agents for treating diarrhea, and antioxidants. Leather tanning is another industrial application for tannins (Amelia, 2015). Tanad acid is the type of tannin substance present in bangle plants. Diarrhea can be effectively treated with tannic acid. Additionally, tannic acid exhibits antimicrobial, antienzymatic, antioxidant, and antimutagenic properties (Hidjrawan Yusi, 2018)

In addition to increasing the fertilizer dose, applying organic fertilizer in the form of cow and chicken manure resulted in an increase in phenolic compounds and flavonoids. When compared to when the rhizome was fresh, the dry rhizome had a higher concentration of phenolic and flavonoid compounds. The content of active compounds in the simplicia is impacted by the drying process. Antioxidant activity is influenced by the total phenolic and flavonoid content (Amelia, 2015). Given that fresh samples are more prone to damage and experience a quicker loss in quality than dry samples, it is advised to use dry samples instead of fresh samples (Julianto, 2019).

The highest phenolic and flavonoid concentrations were found in both fresh and dry rhizomes when chicken

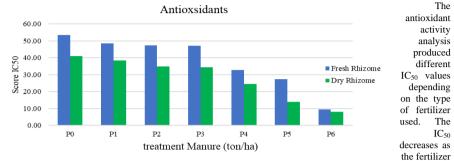
manure was applied at a dose of 60 tons/ha. The highest dose of cow manure, 60 tons/ha, resulted in phenolic compound concentrations of 86.90 mg/L in fresh rhizome and 181.38 mg/L in dry rhizome, while flavonoids were 71.14 mg/L in fresh rhizome and 99.43 mg/L in dry rhizome. Compared to chicken manure at the same dose, this result is smaller. A dose of 60 tons/ha of chicken manure resulted in phenolic compound concentrations in fresh rhizome of 178.56 mg/L and dry rhizome of 202.79 mg/L, while fresh rhizome flavonoids were 181.91 mg/L. In comparison to treatments with organic fertilizers, treatments without fertilizer produced lower phenolic and flavonoid concentrations.

In plants, flavonoids serve as pigments for the flowers, fruits, and roots, as well as occasionally as growth regulators and disease resistance (Julianto, 2019). Catechins are one class of flavonoid compounds present in bangle rhizomes (catechins). Catechins have antioxidant properties, and because they can stop the growth of viruses, bacteria, tumors, and fungi, they can also get rid of rotten and rancid odors (Aprilliza AM et al., 2021). Phenolic compounds are compounds that plants make in response to environmental stress. Phenolic compounds protect DNA from dimerization and damage by blocking UV-B rays and cell death (Hanin & Pratiwi, 2017). Gallic acid is the type of phenolic compound found in bangle rhizome. Gallic acid serves as an antibacterial. antiviral, analgesic, and antioxidant in medicine (Junaidi & Anwar, 2018).

The application of chicken manure resulted in a higher concentration of secondary metabolism because it had a relatively higher P nutrient content than other manures (Simanungkali et al., 2006). Phosphorus can be found in DNA, RNA, and the parts of nucleotides that provide metabolic energy (like ATP). The process of photosynthesis depends heavily on phosphorus. Stunted growth is one of phosphorus deficiency's signs (Khairuna, 2019). The amount of P2O5 in cow manure is 0.2%, compared to 1.3% in chicken manure (Simanungkali et al., 2006). The concentration of secondary metabolism in the form of tannins, phenolic compounds, and flavonoids is influenced by the difference in the P nutrient content between these 2 types of manure. Environmental factors affect the levels of flavonoids and other phenolic compounds in plants, which vary among parts, tissues, and ages of plants. These include air temperature, nutrient availability, water availability, and atmospheric CO2 concentrations (Amelia, 2015).

Antioxsidants





dose increases. A concentration known as IC_{50} is capable of reducing 50% of DPPH free radicals. The greater the antioxidant activity, the lower the IC_{50} value (Widyasanti et al., 2016). Antioxidants are compounds that can absorb or neutralize free radicals, thereby preventing certain diseases caused by free radicals (Parwata, 2016).

The treatment of cow manure, as shown in the graph, results in lower yields than chicken manure. The antioxidant activity of the dried rhizome samples was higher than that of the fresh rhizomes. The highest antioxidant activity was produced by cow manure at a dose of 60 tons/ha, with an IC_{50} value of 9.52 ppm for fresh rhizome and 8.6 ppm for dry rhizome. At a dose of 20 tons/ha in both fresh and dry rhizome conditions, cow manure had a lower IC_{50} value than chicken manure. For fresh rhizomes, the treatment without fertilizer produced an IC_{50} value of around 53.58 ppm, and for dry rhizomes, it was around 40.91 ppm.

Widyasari *et. al* (2016) claim that the antioxidant activity in bangle rhizome is incredibly powerful. Wartano *et. al* (2016) classified antioxidants into five groups based on their IC_{50} values: 50 very strong, 50-100 strong, 101-250 moderate, 251-500 weak, and >501 inactive (Wartono et al., 2021). Except for the treatment without fertilizer in wet rhizome conditions, the IC_{50} value in bangle rhizome in all treatments gave a value of 50 and included a very potent antioxidant. The high secondary metabolic compounds found in the bangle rhizome are inextricably linked to the high antioxidant activity. Secondary plant metabolites like flavonoids and phenolics play a part in antioxidant activity. More phenolic compounds will have a higher level of antioxidant activity (Amelia, 2015).

Conclusion

A cow manure dose of 60 tons/ha is the best dose for plant growth, with an average height increase of 42.78 cm, an increase in the number of leaves of 116.65 pieces, and an increase in the number of tillers of 14.45. A dose of 60 tons/ha of chicken manure produced the best root length of 41.03 cm.

The weight of the rhizomes revealed that the application of cow manure at a dose of 60 tons/ha resulted in the highest yields of dry weight and wet weight, which were about 179.75 g and 822 g, respectively.

A chicken manure dose of 60 tons/ha results in the highest secondary metabolic rate in each parameter, including dry rhizome (phenolic 202.79mg/L, flavonoid 181.91mg/L, and tannin 5406.33mg/L) and wet rhizome (phenolic 178.56mg/L, flavonoid 104.39mg/L), while a chicken manure dose of 40 tons/ha results in the highest tannin Giving chicken manure at a dose of 60 tons/ha produced very strong antioxidant results at 9.52 ppm wet rhizome and 8.06 ppm dry rhizome, according to the antioxidant results.

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2. Mendapat jawaban dari Editor JDMLM

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COMMENTS: (please see the detailed corrections and comments inserted in this manuscript)

- This manuscript only deals with the agronomic aspects of *Zingiber montanum*, not soil management (the effect of adding organic fertilizer on soil properties) → is the soil used in this study considered degraded soil? What is the soil type used in this study?.
- 2. For this manuscript to fit within the scope of this journal (the management of degraded land/soil and management of mining land/soil), the authors have to <u>make adjustments</u> by **adding data on the soil properties affected by the application of cow and chicken manures**, which in turn affects plant growth and yield. The effects of organic fertilizers on soil properties should be discussed accordingly,
- 3. The rationale behind this study is unclear. What was the problem to be solved? *Zingiber montanum* production (agronomic aspects) or soil management aspects?
- 4. Methods are trivial (not presented in detail)

Please be careful in using tenses; when describing Methods and Results, you should use the <u>past</u> tense. The <u>present tense</u> is appropriate for accepted facts, such as the background information presented in the Introduction. In addition, you may use the <u>present tense</u> when you discuss your results and conclusions

<u>Recommendation</u>: **revisions and adjustments** are required; a substantial amount of work is necessary to raise this manuscript to a standard research article

The impact of organic fertilizer on the growth, rhizome yield, and secondary metabolite levels of *Zingiber montanum* grown on degraded soils → soil types? (Ultisols? Inceptisols?)

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Abstract

Indonesia is a major producer of spices in the world. Bangle (the local name of *Zingiber montanum*) is one of the traditional medicines that some people have heard has beneficial effects on the body. Although the bangle has a lot to offer in terms of content and advantages, there is still a huge gap in market demand, which is caused by the cultivation method's shortcomings. One way to boost the bangle plant's productivity is to provide manure. The goal of this study was to establish the ideal manure dosage for bangle plant growth, rhizome yield, and secondary metabolic antioxidant content. The study employed a Randomized Block Design (RAK), with one treatment consisting of organic fertilizer in the form of cow manure and chicken manure, and the levels were divided into seven, namely P0 (control), P1 (cow manure 20 t/ha), P2 (cow manure 40 tons/ha), P3 (cow manure 60 tons/ha), P4 (chicken manure 20 t/ha), P5 (40 t/ha of chicken manure), and P6 (60 t/ha of chicken manure), and then repeated four times. Results of this study indicated that a cow manure dose of 60 tha is the best dose for plant growth, as measured by an average height increase of 42.78 cm, an increase in the number of leaves (116.65 pieces), and an increase in the number of tillers (14.45 pieces) at 18 weeks after planting. A dose of 60 t/ha of chicken manure produced the best root length of 41.03 cm. The highest dry and wet weight yields, of about 179.75 g and 822 g, respectively, came from the rhizome weight of cow manure at a dose of 60 t/ha. The highest secondary

metabolic levels in each parameter were found in dry rhizomes (phenolic 202.79 mg/L, flavonoid 181.91 mg/L, and tannin 5406.33 mg/L), and wet rhizomes (phenolic 178.56 mg/L, flavonoid 104.39 mg/L) with the highest tannin compound at around 4144.83mg/L in chicken manure dose of 40 t/ha. According to the antioxidant results, providing chicken manure at a dose of 60 t/ha resulted in very strong antioxidant results in each of the wet and dry rhizomes, which were respectively 9.52 ppm and 8.06 ppm.

Keywords: organic fertilizer, bangle, secondary metabolism

Introduction \rightarrow in this section, the existing problems of the soils used for growing Zingiber must be described

One of the biggest producers of spices worldwide is Indonesia. Bangle (the local name of *Zingiber montanum*) is a traditional medicine that some people believe has beneficial properties for the body. Bangle (*Zingiber montanum*), a Zingiberaceae family member, has long been used in traditional medicine (Noviyanto et al., 2020). Bangle rhizome is aromatic, which distinguishes it from other Zingiberaceae family members. Bangle, in its physical form, is similar to other spices in the Zingiberaceae family (Fernandarisky et al., 2020). The bangle is rich in saponins, flavonoids, phenolic compounds, essential oils, tannins, steroids, triterpenoids, antioxidants, vitamin C, vitamin E, and carotene. According to Noviyanto et al. (2020), Bangle rhizome extract has pharmacological activity as an antibacterial, laxative, pancreatic lipase inhibitor, and protects cells from oxidative stress caused by H₂O₂.

Due to insufficient fertilization, pest control, soil management, and other cultivation techniques, bangle rhizome production frequently experiences a significant gap between the maximum and minimum yields or is said to frequently experience erratic fluctuations in yields. There are not enough references for growing this plant. Bangle cultivation can yield fresh rhizomes weighing 10-20 tons per acre (Evizal, 2013). One very important cultivation technique is fertilization.

Other than its primary function as a stem, the rhizome may serve other purposes, the most common of which is to serve as a storage site for certain metabolism (metabolic) products. Metabolic products can be used as drugs in some cases, but their content is sometimes uncertain and tends to be lower. Temperature, nutrition, water availability, and CO_2 levels in the atmosphere are all factors that can influence secondary metabolic levels (Amelia, 2015). The availability of complete and balanced nutrients that can be absorbed by plants is a factor that influences plant growth and production (Dewanto et al., 2017)

Giving the bangle plant organic fertilizer is one way to boost its own productivity. Organic fertilizers can be in the form of solid or liquid fertilizers made from dead plants, animal dung, animal parts, or other organic wastes that have undergone an engineering process. They can also be enriched with microorganisms or minerals (Permentan, 2011). Manure is one of the most commonly used organic fertilizers. Manure is processed livestock manure that is applied to agricultural land in order to improve soil fertility and structure. The nutrients in manure vary depending on the source.

According to Hartatik (2015), cow manure contains N (6 kg/t), P (1.5 kg/t), K (3 kg/t), Ca (1.2 kg/t), Mg (1 kg/t), and S (0.9 kg/t). Chicken manure itself contains N (15 kg/t), P (7 kg/t), K (8.9 kg/t), Ca (3 kg/t), Mg (8.8 kg/t) and S (0.3 kg/t). Animal manure contains a lot of nitrogen as well as metallic minerals like magnesium, potassium, and calcium. The primary benefit of manure is that it preserves the physical structure of the soil, allowing roots to grow properly, as well as supporting the biological and chemical properties of the soil (Melsasail et al., 2019). Therefore, the purpose of fertilization is to replenish lost nutrients and increase the amount of nutrients available to plants, thereby increasing plant quality and quantity.

Matarials and Methods

Place and Time

The study was conducted from September 2021 to March 2022, lasting about 5 months. The research location was in the experimental field of Mulawarman University Teluk Dalam, L2, Tenggarong Sebrang, East Kalimantan. The second place is in the Laboratory of Post-Harvest and Packaging of Agricultural Products, Faculty of Agriculture, Mulawarman University.

Research Design

The study was designed using a randomized block design with one treatment factor using organic fertilizer in the form of cow and chicken manure. The levels were then divided into 7 groups, with P0, P1, P2, P3, P4, P5, and P6 each receiving a different dose of each type of manure. Each treatment was repeated four times. The following dosages were used:

P₀: Control (without fertilizer)

- P1: 20 t cow manure /ha
- P2: 40 t cow manure /ha
- P3: 60 t cow manure /ha
- P₄: 20 t chicken manure /ha
- P5: 40 t chicken manure /ha
- P6: 60 t chicken manure /ha

The plot had a length of 6 m and a width of 1 m. Planting one seed per planting hole results in a spacing of approximately 50×100 cm. To prevent waterlogging and seedling rot, seedlings are planted in ditches with good drainage. In order to facilitate landfilling later, planting is done in the trench. \rightarrow characteristics of materials used for this study (soil, cow manure and chicken manure) have to be presented in this Materials and Methods section, as their characteristics are very important to support the discussion

Data Analysis

Plant height, number of leaves, and number of tillers were measured at 3, 6, 9, 12, 15, and 18 WAP (weeks after planting). After the plants were harvested, fresh weight, dry weight, root length, secondary metabolic, and antioxidant levels were measured. The data obtained were subjected to the analysis of variance (ANOVA) with a 5% confidence level, followed by a 5% level DMRT (Duncan Multiple Range Test) to detect significant differences among treatments ... The results of the secondary metabolic level identification and antioxidant activity tests were analyzed qualitatively using the descriptive method. Comparing phytochemical compound levels in each treatment was based on secondary metabolism levels. Antioxidant activity was assessed by comparing the IC50 values in each treatment. A spectrophotometry method was used for all of the parameters of the secondary metabolic level test.

Results

The results of an analysis of variance (ANOVA) at a 5% level showed that the treatments of giving organic fertilizers in the form of chicken and cow manure gave significant differences in plant height, number of tillers, number of leaves, root length, fresh weight of rhizomes, and dry weight of rhizomes. Only root length that was not affected significantly by the treatments.

Plant growth

Table 1 shows that when the plant was about 6 weeks old, the application of cow manure at a dose of 60 t/ha produced the best plant growth (26.16 cm), followed by chicken manure at a dose of 60 t/ha, chicken manure of 40 ts/ha, and cow manure of 40 t/ha. In comparison to the previous week, the plant's age 9 weeks after planting showed a very rapid increase in plant height. At 9 weeks after planting , the best dose was 40 t/ha of chicken manure with an average plant height addition of about 32.45 cm. The best results were obtained at week 12, with a cow manure at a dose of 60 ts/ha that yielded an average plant height of 37.24 cm. The application of cow manure at a dose of 20 t/ha and chicken manure at a dose of 20 t/ha and set at 15 weeks after planting was 60 t cow manure /ha, with an average plant height of 40.47 cm, and 38.38 cm of chicken manure. The highest dose of cow manure yielded an average plant height of 42.78 cm at 18 weeks after planting.

Number of Tillers

Table 2 shows that the highest number of tillers was found at a dose of 60 t/ha of chicken manure, with an average of 1.65 tillers at 6 weeks after planting. At the age of 9 weeks after planting , a control with an average of about 2.55 tillers produced number of tillers that were not significantly different from chicken manure 20 t/ha. The best application was 60 t/ha of cow manure with an average of 4.15 tillers. At 12 weeks after planting , the effect of manure treatment revealed that the best dose was 40 t/ha chicken manure, with an average of 6.65 tillers. This best dose did not differ significantly between chickens and cows manure at 60 t/ha or chickens manure at 20 t/ha. Cow and chicken manure at a dose of 60 t/ha at 15 weeks after planting produced the highest yields, with cow manure yielded 9.50 tillers and chicken yielded 9.00 tillers, respectively. At 18 weeks, the control did not differ significantly from the cow manure doses of 20 and 40 t/ha. The highest number of tillers was observed for the treatment of cow manure at 60 t/ha with an average of 14.45 tillers and chicken manure at 60 t/ha with an average of 13.37 tillers.

Number of Leaves

Table 3 shows that after 6 weeks of treatment with a dose of 20 t chicken manure /ha, the number of leaves were not statistically significantly different from the control but significantly different from other treatments. The best

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dose of 60 t/ha cow manure, was produced at around 9 weeks, with an average increase in the number of leaves of 37.95 leaves. At 12 weeks, the control showed no significant difference from cow manure of 20 and 40 t/ha, as well as chicken manure of 20 and 40 t/ha. Cow manure of 60 t/ha with an average of 52.80 leaves provided the best dose at 12 weeks after planting . The highest dose was found in cow manure at a rate of 60 t/ha in week 15, with an average of 84.55 leaves. The application of 60 t/ha cow manure produced the largest number of leaves of 116.65 leaves in the 18th week, that significantly difference from the control. However, the application of 60 t/ha chicken manure increased the number of leaves by 105.80 leaves.

Rhizome root length, wet weight and dry weight

Table 4 shows that the lowest root length of 24.36 cm was obtained by the application of 20 t/ha cow manure . The control yielded root length that was not statistically different from that yielded by the application of 20 t/ha cow and chicken manure as well as the highest dose. This result indicates that applying different doses of manure had no effect on the root length of the bangle plant.

The chicken manure dosage of 20 t/ha yielded the lowest bangle rhizome fresh weight of 392.35 g. While the control yielded fresh weightthat was not significantly different from 20 t/ha and 40 t/hacow and chicken manure. The fresh weight of the bangle rhizome due to the application of 40 t/ha chicken and cow manure also did not differ significantly from those from 60 t/ha chicken manure. The treatment of 60 t/ha cow manure yielded the highest rhizome fresh weight of 822.00 g that was significantly for all treatments.

The lowest dry weight of bangle rhizome was shown by the cow and chicken manure treatment at a dose of 20 t/ha, respectively 86.00 g for cow manure treatment and 78.25 g for chicken manure treatment. These values were lower than that of the control, with an average of 93.75 g. The control yielded statistically insignificantly different rhizome dry weight with chicken manure at 20 and 40 t/ha, cow manure at 20 and 40 t/ha, and chicken manure at 60 t/ha cow manure with an average rhizome dry weight of 179.75 g, followed by 60 t chicken manure /ha with an average rhizome dry weight of 135.75 g

Table 1. Effect of Cow and Chicken Manure on Rhizome Height (in cm) \rightarrow Tables have to be presented in Word format (generated from Excel format), not in JPEG format, as JPEG format cannot be edited.

Manure Treatment	Weeks after Planting (MST)						
(ton/ha)	6	9	12	15	18		
Control	11,38 a	18,61 a	24,68 a	20,41 a	18,82 a		
Cow 20 ton/ha	17,46 b	20,26 ab	25,44 a	24,02 ab	28,51 b		
Cow 40 ton/ha	20,51 c	27,95 b	29,81 ab	35,57 cd	37,19 c		
Cow 60 ton/ha	26,16 e	31,18 b	37,24 c	40,47 d	42,78 c		
Chicken 20 ton/ha	17,36 b	27,21 b	30,16 abc	29,15 bc	28,82 b		
Chicken 40 ton/ha	22,84 cd	32,45 b	34,83 bc	37,61 cd	36,37 c		
Chicken 60 ton/ha	25,68 de	32,17 b	36,84 bc	38,38 d	39,22 c		

ton/ha is abbreviated to t/ha

Table 2. Effect of Cow and Chicken Manure on Rhizome number of tillers (in weeks) \rightarrow Tables have to be presented in Word format (generated from Excel format), not in JPEG format, as JPEG format cannot be edited.

Manure Treatment	Weeks after Planting (MST)						
(ton/ha)	6	9	12	15	18		
Control	0,8 a	2,55 a	3,95 a	5,80 a	8,60 a		
Cow 20 ton/ha	0,7 b	3,45 b	5,20 b	6,60 a	10,40 ab		
Cow 40 ton/ha	1,7 ac	3,40 b	5,05 ab	7,35 ab	11,55 b		
Cow 60 ton/ha	1,6 c	4,15 b	6,10 bc	9,50 c	14,45 d		
Chicken 20 ton/ha	1,3 bc	3,35 ab	5,70 bc	7,40 ab	11,05 b		
Chicken 40 ton/ha	1,5 c	4,00 b	6,65 c	8,45 bc	12,15 bc		
Chicken 60 ton/ha	1,65 c	3,75 b	6,05 bc	9,00 c	13,70 cd		

Table 3. Effect of Cow and Chicken Manure on number of Rhizome Leaves (in weeks) → Tables have to be presented in Word format (generated from Excel format), not in JPEG format, as JPEG format cannot be edited.

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Manure Treatment	Weeks after Planting (MST)						
(ton/ha)	6	9	12	15	18		
Control	4,70 a	19,60 a	35,80 a	52,25 a	77,55 a		
Cow 20 ton/ha	5,55 a	25,00 ab	41,05 ab	55,65 a	83,80 a		
Cow 40 ton/ha	9,65 b	28,25 abc	42,70 abc	66,00 ab	95,35 ab		
Cow 60 ton/ha	10,05 b	37,95 c	52,80 c	84,55 c	116,65 c		
Chicken 20 ton/ha	9,20 b	26,00 ab	40,25 ab	56,85 a	81,75 a		
Chicken 40 ton/ha	9,65 b	30,90 bc	43,25 abc	67,05 bc	91,35 ab		
Chicken 60 ton/ha	11,05 b	30,45 abc	50,75 bc	79,55 bc	105,80 bc		

Table 4. Effect of Cow and Chicken Manure on Root Length and Rhizome Weight (in 18 week) \rightarrow Tables have to be presented in Word format (generated from Excel format), not in JPEG format, as JPEG format cannot be edited.

Manure Treatment (ton/ha)	Root Length (cm)	Rhizome wet weight (g)	Rhizome dry weight (g)
Control	31,90 ab	415,25 ab	93,75 ab
Cow 20 ton/ha	24,36 a	444,75 ab	86,00 a
Cow 40 ton/ha	35,36 b	530,00 bc	119,00 ab
Cow 60 ton/ha	36,50 b	822,00 d	179,75 c
Chicken 20 ton/ha	33,20 ab	393,25 a	78,25 a
Chicken 40 ton/ha	38,95 b	487,50 abc	99,75 ab
Chicken 60 ton/ha	41,03 b	618,75 c	134,75 bc

Notes: Based on Duncan Multiple Range Tast (DMRT) at a 5% significance level, values in the same columns that are followed by the same letter do not differ significantly.

Table 5. Secondary Metabolic Levels in Bangle Rhizome in Each Treatment (mg/L). → Tables have to be
presented in Word format (generated from Excel format), not in JPEG format, as JPEG format cannot be edited.

a		Level (mg/L)			
Condition	Treatment	Phenolic	Flavonoid	Tanin	
	Control	31,64	23,08	2034,83	
	Cow 20 ton/ha	43,18	41,55	2991,50	
	Cow 40 ton/ha	77,03	64,30	3151,50	
Fresh	Cow 60 ton/ha	86,90	71,14	3198,17	
	Chicken 20 ton/ha	97,67	74,79	4086,50	
	Chicken 40 ton/ha	107,54	78,71	4144,83	
	Chicken 60 ton/ha	178,56	104,39	3861,33	
	Control	124,97	38,44	1932,33	
	Cow 20 ton/ha	133,56	67,23	2504,00	
	Cow 40 ton/ha	148,44	68,76	3034,83	
Dry	Cow 60 ton/ha	181,38	99,43	4734,67	
	Chicken 20 ton/ha	175,23	120,06	4903,00	
	Chicken 40 ton/ha	198,69	156,10	5088,00	
	Chicken 60 ton/ha	202,79	181,91	5406,33	

Note: The number followed by yellow denotes the best outcome in each observation variable for the flavonoid, tannin, and phenolic contents.

Table 6. Antioxidant based on IC50 value \rightarrow Tables have to be presented in Word format (generated from Excel format), not in JPEG format, as JPEG format cannot be edited.

	Fertilizer Dose ton/ha						
Antioxidant (IC50) (mg/L)	Control	Control			Chicken		
-	Control	20	40	60	20	40	60
Fresh Rhizome	53.58	48.55	47.36	47.14	32.73	27.42	9.52
Dry Rhizome	40.91	38.30	34.78	34.46	24.41	14.05	8.06

Note: The smaller the IC50 value, the stronger the antioxidant

Secondary metabolic level

In accordance with the findings of the secondary metabolism test, the rhizome of the bangle plant contained phenolic, flavonoid, and tannin-containing active substances, and also steroids, alkaloids, and terpenoids qualitatively. Different levels of the compounds involved in this secondary metabolism are evident in each organic fertilizer application (Table 5). Different concentrations were produced by the concentration of active substances in the bangle rhizome. The data mentioned above demonstrated that, despite using the same amount of fertilizer, the active compound content of the bangle rhizome was highest when the rhizome was dry (low moisture content) as opposed to when the rhizome was still fresh. The amount of chicken manure that produced the highest phenolic content in the rhizome under fresh and dry conditions, correspondingly around 178.56 mg/L and 202.79 mg/L, was 60 t/ha. A dose of 60 t/ha of chicken manure also yielded higher levels of active flavonoids and tannins than other doses. When compared to the fertilizer treatment, the control had the lowest active compound content. When treated with cow manure, yields were lower than when treated with chicken manure at the same dose.

Antioxidant

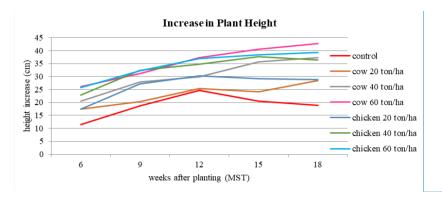
Results of antioxidant analysis of bangle rhizomes using several samples based on manure dose and fresh and dry rhizome condition are shown Table 6. IC_{50} value obtained described how well the sample captured free radicals. The dose of 60 t chicken manure s/ha was found to have the lowest IC_{50} value of 9.52 ppm in the fresh sample, , while the control had the highest IC_{50} value of 53.58 ppm in fresh rhizome conditions. The same quality was obtained when dry rhizome conditions were used for the analysis; specifically, the dose of 60 t chicken manure /ha chicken manure produced the lowest IC_{50} value and the largest was in the control. [The plant's antioxidants are more potent the lower the IC_{50} value. Cow manure is always treated with an IC_{50} value higher than chicken manure.]

Discussion

Plant Height

According to the Table 1, the average increase in plant height starting at 6.9, 12, 15, and 18 WAP tended to fluctuate. At the age of 6 weeks, the treatment without fertilizer (control) continued to grow until week 12 when it reached its peak with an average height increase of about 24.68 cm, before the delining height at the following weeks. In order for a plant to grow, nutrients must be obtained from the soil by the roots through their root hairs (Sudewi et al., 2022). Organic matter affects plant growth by influencing the physical, chemical, and biological properties of the soil (Anwar, 2013). The more organic matter is provided, the faster the plant will grow. Compared to chicken manure, cow manure typically produces better plant growth . According to ((Hartatik et al. (2015), cow manure contain N (6 kg/t), P (1.5 kg/t), K (3.0 kg/t), Ca (1.2 kg/t), Mg (1.0 kg/t), and S (0.9 kg/t), and these nutrients can support the growth of Bangle plants, which have a long harvest period.

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The application of chicken manure at all levels significantly increased plant height at 9 weeks after planting, but at 12 weeks, the plant height slightly decreased. In the 20 t/ha chichen manure treatment, the plant height was in average of 30.16 cm at 12 weeks after planting and decreased in the following weeks. High nitrogen elements are found in chicken manure \rightarrow how many %?. Although the amount of nitrogen required by plants is always higher than other nutrients, a deficiency or excess of nitrogen can hinder and disrupt plant growth (Raja et al., 2021). After planting, the growth rate of the bangle plant accelerated between 2 and 5 months. As plants get older, their growth rate for height starts to slow down (Rosita et al., 2005).

According to Hartatik et al. (2015), applying chicken manure always results in the best plant response in the first growing season. This is because chicken manure decomposes relatively quickly and has enough nutrients compared to other manures of the same weight. Table 1 shows that the application of chicken manure tended to increase plant height rapidly at 6, 9, and 12 weeks of age, then declined as plant age increased. Large-scale application of chicken manure is thought to be less effective because the nutrients will exhaust quickly.

The same result was also shown by the application of chicken manure at a dose of 40 t/ha which decreased the plant height, the maximum height increase at this dose was at 15 weeks with an average height increase of 37.61 cm. When compared to the other two doses of chicken manure, the plant height for the 60 t/ha chicken manure was different. The plant height increase over 18 weeks demonstrates this, but the increase in plant height was typically not too different from the previous weeks. Even though the application of cow manure at a dose of 40 t/ha, at the end of the observation at 18 weeks the increase in height was more apparent and might even have exceeded that of the chicken manure at a dose of 40 t/ha, which caused a decrease in plant height.

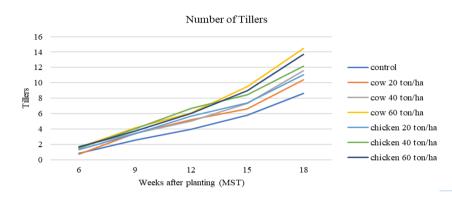
The addition of cow manure improves soil permeability, total pore space, aggregate stability, bulk density, texture, color, and temperature (Sudewi et al., 2022). A dose of 60 t/ha of chicken and cow manure had the tendency to produce steady, dependable results. The application of cow manure at a dose of 60 t/ha tended to yield less than chicken manure at doses of 40 and 60 t/ha from the start of planting until the plant was 9 weeks old, but the yields increased in the following weeks.

The plant's need for nutrients grows as it ages. If the nutrient requirements are not met and the nutrients are not readily available, plants may experience nutrient deficits at specific times. According to Rosita et al. (2005), bangle plants absorb N (0.06 - 3.07 g), P (0.01 - 0.53 g), and K (0.10 to 2.25 g) at 2 to 10 months after planting in the canopy. N is the nutrient that is most required in the plant canopy itself. The primary nutrient for plants, nitrogen, is typically essential for the development and expansion of vegetative parts of plants, such as leaves, stems, and roots (Purba et al., 2021). A sufficient supply of plant N is indicated by high photosynthetic activity, good vegetative growth, and dark green plant colors (Nurhayati, 2021).

Due to the individual characteristics of each animal, which are influenced by the type of feed and the animal's age, each manure contains a different mix of nutrients (Nurjanah et al., 2020). Because each treatment dose of fertilizer has a different nutrient content, they all produce different yields and have different recommended doses. Due to their movement with crop yields, surface runoff, erosion, or evaporation, nutrients in the soil will gradually decrease over time (Lawenga et al., 2015).

Number of Tillers

The table of the total number of tillers from each level reveals results that increase with plant aging and are influenced by the quantity of fertilizer applied, as shown in Table 2. Plants without fertilizer developed more tillers every week, but the growth was typically modest. This slight increase resulted from the fact that during the initial stages of planting, the products of photosynthesis were utilized for the vegetative development of plants.



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In comparison to manure application, treatment without fertilizer produced the lowest yield. Data presented in Table 2 show that there was a noticeable increase in the number of tillers at 18 WAP of age. A plant needs nutrients for its physiological processes during growth and development. Plant growth and production will be subpar due to a lack of nutrients (Purba et al., 2021).

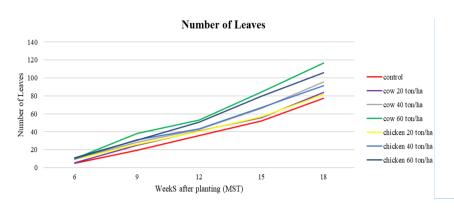
Functions of organic matter as a biological buffer so that the soil can supply plants with a balanced amount of nutrients (Hartatik et al., 2015). Loosening the topsoil, increasing water absorption and storage, and boosting soil fertility are all important functions of manure (Yulianto et al., 2021). A sudden rise in the number of tillers can result from the ease with which new shoots can emerge from loose, moist soil.

At the start of planting, there were typically fewer and nearly identical numbers of tillers in each treatment. The nutrients in this fertilizer are not readily available to plants, which is the cause of the slow plant growth at the start of the planting period. The extent of these materials' mineralization or decomposition has a significant impact on the nutrients' availability. Manure's low nutrient availability is partially caused by the presence of N, P, and other elements in complex compounds that are challenging to decompose (Hartatik et al., 2015).

At 6 weeks after planting, all treatments tended to be similar and the differences between the tillers in each treatment tended to be minimal. Although cow manure at a dose of 60 t/ha was the best dose with an average number of tillers of 14.45 tillers, chicken manure typically produced better results than cow manure at the same dose. In comparison to other manure doses, chicken manure 40 t/ha at 12 weeks after planting produced the best results with 6.65 tillers.

Number of Leaves

An increasing number of leaves are produced each week as a result of the weekly application of cow and chicken manure. Table 3 show that at about 12 weeks of age, the number of leaves increased significantly. Every week, the increase varied depending on the treatment. The number of leaves significantly increased with a dose of 60 t/ha of cow manure, averaging 15–37 leaves every three weeks. Similarly, the number of leaves tended to increase when manure was applied in the same amount. Both cow and chicken manure at a dose of 20 t/ha and 40 t/ha produced a nearly identical number of leaves during plant growth.



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In addition to the nutrients that plant's needs, manure also contains humic, fulvic acids, growth hormones, and other substances that promote plant growth and increase nutrient uptake by plants (Hartatik et al., 2015). The amount of photosynthesis is influenced by the number of leaves present, and plants with more leaves may produce heavier and bigger rhizomes as a result.

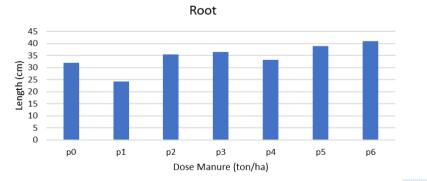
The number of leaves added is also affected by the number of shoots and plant height. The number of leaves will increase as the plant ages and grows taller, produces more leaves on a single stem, and produces more tillers. The nutrients required for plant growth are present in sufficient amounts in manure. The related observation variables will be impacted by the food's growth quality and planting age.

In relation to the addition of the number of leaves, the most influential element is N. In comparison to other nutrients, nitrogen is required in sufficient amounts for plant growth. N makes up 40–50% of the dry weight of protoplasm, the living component of plants (Nurhayati, 2021). Since protein is the source of all plant enzymes, nitrogen participates in all enzymatic processes in plants. Additionally, nitrogen is one of the constituent elements of chlorophyll, the primary component of chloroplasts, and it contributes to improving the quality and quantity of the dry matter produced (Vladimir, 2021).-> this reference cannot be traced electronically

Fertilizer use and the amount of nutrients in the soil have a significant impact on how plants grow and develop. Nutrient uptake is restricted by nutrients in a minimum state (Purba et al., 2021). In terms of the addition of leaves, the treatment of plants without fertilizer differs significantly enough for each observation. In comparison to other treatments, plants without fertilizer produce the lowest yield.

Root Length

The lowest root length was observed for the cow manure dose of 20 ts/ha treatment with an average root length of about 24.36 cm which was lower than the control. With an average root length of 41.03 cm, the application of chicken manure yielded the longest roots. When plants respond to water shortages by reducing the rate of transpiration to conserve water, the roots play a crucial role (Torey et al., 2013). Plant roots have a significant impact on overall plant growth and development. The failure of the root function will result in a complete change in the plant for the top (Nurhayati, 2021).



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Manure can bind water in the soil. Because the soil around the roots in the deeper layers is still moist, the roots will continue to grow. Maximizing exposure to groundwater will encourage the growth of roots (Torey et al., 2013). Plant roots directly respond to the physical characteristics of the soil (Lawenga et al., 2015).

Data presented in Table 4 show that the application of chicken manure yielded better root length than cow manure. The use of organic fertilizers can loosen the soil, increase aeration, and increase the soil's capacity to hold water, all of which can improve the physical properties of the soil (Raja et al., 2021). Additionally, organic matter has the ability to control soil temperature, slow down phosphorus fixation, increase soil cation exchange capacity, and lessen the leaching of nutrients like potassium, calcium, and magnesium (Guimarães et al., 2019). Another environmental factor that has been shown to affect the nitrate absorption process is the temperature around the roots (Vladimir, 2021). \rightarrow this reference cannot be traced; please replace it with others

The initial analysis of the soil revealed that the pH ranged from 3.86 to 4.86. Al is common excessively in acidic soil, and it can poison plants and bind phosphorus (P). Low pH soil can hinder plant growth by preventing the roots from properly absorbing nutrients. Giving chicken manure up to 5–25 t/ha, as demonstrated by Tufaill et al. (2014), could raise the pH of soil from 5.0 to 5.8–6.4. By raising pH, Al in the exchangeable form will be reduced, and nutrients will become more available to plants.

According to Rosita et al. (2005), nutrient uptake on the roots of bangle plants at 2-10 months after planting was as follows: N (0.01 - 0.52 g), P (0.002 - 0.15 g), and K (0.02 to 0.82 g). It was discovered that the roots of the bangle plant had more K buildup than N and P. K is primarily used to aid in the synthesis of proteins and carbohydrates. In the face of drought, illness, and pests, potassium gives plants strength (Purba et al., 2021). Organic fertilizers can help the soil's physical and chemical composition, which will facilitate root development. Up until the soil reaches its critical water potential, plant roots expand into moist soil and draw water (Solichatun et al., 2005). The looseness of the soil can promote root development. Strong roots will make it simpler for plants to absorb nutrients and water

Rhizome fresh Weight

Plant biomass is a common parameter used to study plant growth. The fresh weight of the plant describes the water and moisture content of the plant. The plant will weigh more when wet the more fertile it is (Supandi, 2021). When plant nutrient requirements are met, yields will be optimal (Purba et al., 2021). The rhizome of the bangle plant is the part that is most advantageous for cultivation. One could also argue that this rhizome's fresh weight is a crucial factor in determining how well bangle plant cultivation is going. The cultivation method is better and more productive the more weight of the wet rhizome can be obtained.

Rosita (2005) found that giving 250 kg/ha of urea, 250 kg/ha of SP36, 250 kg/ha of KCl, and 20 tons/ha of manure resulted in a fresh bangle rhizome weight of 311.39 g/plant 5 months after planting. According to the results of the application of the organic fertilizers at the age of 18 weeks, cow manure at a dose of 60 t/ha produced the highest fresh weight of rhizomes, averaging 822 g/plant, and chicken manure at a dose of 20 t/ha produced the lowest fresh weight of rhizomes, averaging 393.25 g/plant. Manure increases crop yield and quality while also enhancing the chemistry, physical characteristics, and biological properties of the soil (Seker et al., 2011). Data presented in Table 4 demonstrate that the yield of fresh weight of rhizomes dwith increasing manure dosage.

The physical condition of the soil must support plant growth in addition to a supply of adequate and balanced nutrients (Lawenga et al., 2015). These soil aggregates will keep the soil in a loose condition (Anwar, 2013). Cow manure will enhance the physical characteristics of the soil. Improved soil physical characteristics include things like increased permeability, total pore space, aggregate stability, bulk density, texture, color, and temperature (Sudewi et al., 2022).

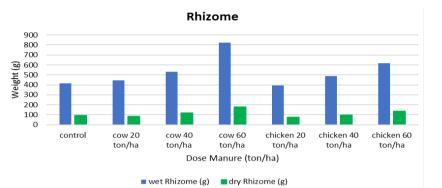
Intensive tillage affects the physical properties of the soil. Low organic matter soils will have more severe damage to the soil's structure (Anwar, 2013). When the soil does not receive enough water and becomes dense and hard, soil damage is evident. Plant rhizomes will not be able to grow or spread out in compacted or hard soil. The ability to maintain loose soil conditions that are difficult to harden or compact increases with the amount of organic matter added.

Additionally, manure helps to improve soil structure, cation exchange capacity, and water resistance. Giving manure has the indirect effect of making it simpler to keep water in the soil (Yuliana et al., 2015). Since water availability plays a significant role in plant growth, water frequently restricts the growth and development of cultivated plants.

The plants will experience drought conditions if there is not enough water in the soil. Due to decreased primary metabolism, reduced leaf area, and decreased photosynthetic activity, drought stress can lower plant productivity (biomass). Smaller leaves grow as a result of a lack of water during the vegetative stage, which can reduce light absorption. Lack of water also inhibits the synthesis of chlorophyll and some enzymes, such as nitate reductase, from working (Solichatun et al., 2005).

Organic substances in the soil may have physiological effects on plant growth that are direct or indirect (Syaiful Anwar, 2013). Compared to other types of manure, chicken manure contains a fair amount of P. This is due to the

fact that chicken manure contains feed (Sudewi et al., 2022). Phosphorus aids in the growth of plant roots, photosynthesis, transfer respiration, cell division, and growth (Supandi, 2021). The number of cells increases more quickly when they divide quickly, which causes the rhizome to grow larger.



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Rhizome Dry Weight

The relationship between plant growth and the quantity and concentration of mineral nutrients in plant tissues is known as dry weight (Purba et al., 2021). Dry weight reflects a plant nutritional status because it is affected by the rate of photosynthesis and respiration in each treatment. Based on the collected data, it was determined that applying chicken and cow manure at a dose of 20 t/ha resulted in lower dry weight yields than the control. Additionally, the results from the application of 40 t/ha manure dose were not significantly different from the control. Many nutrients, such as N, P, and K, build up in the canopy when the bangle plant is between 2 and 7 months after planting to (Rosita et al., 2005). This is the active vegetative formation stage.

The application od cow manure at a dose of 60 t/ha demonstrated different results and produced significantly better outcomes than other doses of chicken manure. The amount and timing of fertilizer applied can impact crop yields, among other things. Organic matter plays a crucial role in soil health because it can create stable soil aggregates, increase soil fertility, and serve as a source of energy for organisms (Nurjanah et al., 2020).

Rosita et al. (2005), reported that the N, P, and K amounts of nutrient uptake in dry rhizomes of Bangle plants aged 2 to 10 months were N (0.01 to 4.89 g), P (0.002 to 1.04 g), and K (0.01 to 2.34 g), respectively. It is clear that as plants get older, they are able to absorb an increasing amount of N, P, and K nutrients. As can be seen, N is the nutrient that has accumulated in the rhizome in the greatest amounts.

The application of manure enhances the chemical, physical, and biological properties of the soil, increase crop yield, and improves crop quality (Yolcu, Turan et al., 2011). High organic matter soils have beneficial microorganisms that encourage the breakdown of organic matter and release inorganic nutrients that are then available for plant uptake (Seker et al., 2011). Organic fertilizers can help to create ideal conditions in the soil for microorganisms that are beneficial to plants.

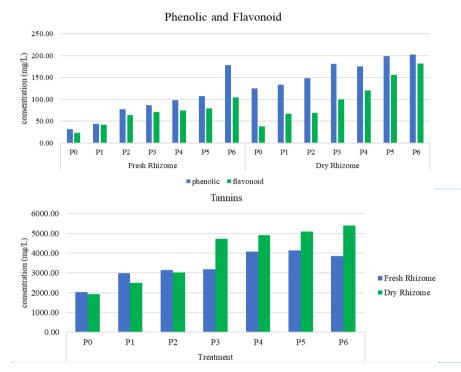
Chicken manure is an organic fertilizer with high nitrogen content, despite not being the best dose for bangle rhizome weight yield. As they ensure the best nutrient management for plants, such fertilizers should be used promptly to partially replace chemical fertilizers (Guimarães et al., 2019).

Secondary metabolic levels (phenolic compounds, flavonoids and tannins)

The results of laboratory analysis found that the positive bangle rhizome contains compounds in the form of phenolics, tannins and flavonoids. These findings are consistent with Amalia et al, (2021), which found that the Bangle plant contains secondary metabolism in the form of alkaloids, phenolic compounds, flavonoids, saponins, and triterpenoids. These compounds respond differently to the concentration of organic fertilizer applied in the form of cow and chicken manures. Table 5 shows the outcomes of these phytochemicals.

According to Table 5, the amount of tannin compounds increased as manure dosage rose. The application of chicken manure or cow manure with three doses of 20, 40, and 60 t always increased the tannin concentration in the rhizome as the dose increased. When compared to cow manure, applying chicken manure produced significantly better results. It is evident that using 20 t/ha of chicken manure instead of 60 t/ha of cow manure resulted in a higher tannin concentration.

Dry rhizomes produced a higher concentration of tannins than fresh rhizomes, which produced different results regarding tannin concentration. The concentration of tannins in fresh rhizomes increased non-significantly with the addition of cow manure, whereas the concentration of tannin compounds in fresh rhizomes decreased with the



increase in the dose of cow manure. In comparison to the use of manure that increased fresh and dry rhizomes, the control provided the lowest tannin concentration.

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Tannins are chemical substances that have an astringent and bitter flavor. These substances act as controlling substances in plant metabolism as well as important defenses against herbivores and pests that prey on plants (Julianto, 2019). Tannins are metabolically active substances with multiple uses, including as astringents, antibacterial agents for treating diarrhea, and antioxidants. Leather tanning is another industrial application for tannins (Amelia, 2015). Tanad acid is the type of tannin substance present in bangle plants. Diarrhea can be effectively treated with tannic acid. Additionally, tannic acid exhibits antimicrobial, antienzymatic, antioxidant, and antimutagenic properties (Hidjrawan Yusi, 2018)

In addition to increasing the fertilizer dose, applying organic fertilizer in the form of cow and chicken manure resulted in an increase in phenolic compounds and flavonoids. When compared to when the rhizome was fresh, the dry rhizome had a higher concentration of phenolic and flavonoid compounds. The content of active compounds in the simplicia is impacted by the drying process. Antioxidant activity is influenced by the total phenolic and flavonoid content (Amelia, 2015). Given that fresh samples are more prone to damage and experience a quicker loss in quality than dry samples, it is advised to use dry samples instead of fresh samples (Julianto, 2019).

The highest phenolic and flavonoid concentrations were found in both fresh and dry rhizomes when chicken manure was applied at a dose of 60 t/ha. The application of the highest dose of cow manure of 60 t/ha, resulted in phenolic compound concentrations of 86.90 mg/L in the fresh rhizome and 181.38 mg/L in the dry rhizome, while flavonoids were 71.14 mg/L in fresh rhizome and 99.43 mg/L in dry rhizome. Compared to chicken manure at the same dose, this result is smaller. A dose of 60 t/ha of chicken manure resulted in phenolic compound concentrations in the fresh rhizome of 178.56 mg/L and dry rhizome of 202.79 mg/L, while fresh rhizome flavonoids were 104.39 mg/L and dry rhizome flavonoids were 181.91 mg/L. In comparison to treatments with organic fertilizers, treatments without fertilizer produced lower phenolic and flavonoid concentrations.

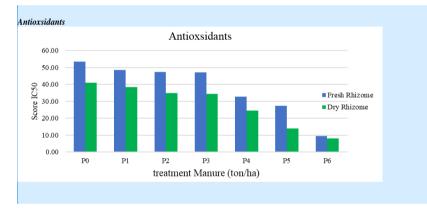
In plants, flavonoids serve as pigments for the flowers, fruits, and roots, as well as occasionally as growth regulators and disease resistance (Julianto, 2019). Catechins are one class of flavonoid compounds present in bangle rhizomes (*catechins*). Catechins have antioxidant properties, and because they can stop the growth of

viruses, bacteria, tumors, and fungi, they can also get rid of rotten and rancid odors (Aprilliza et al., 2021). Phenolic compounds are compounds that plants make in response to environmental stress. Phenolic compounds protect DNA from dimerization and damage by blocking UV-B rays and cell death (Hanin and Pratiwi, 2017). Gallic acid is the type of phenolic compound found in bangle rhizome. Gallic acid serves as an antibacterial, antiviral, analgesic, and antioxidant in medicine (Junaidi and Anwar, 2018).

The application of chicken manure resulted in a higher concentration of secondary metabolism because it had a relatively higher P nutrient content than other manures (Simanungkali et al., 2006). Phosphorus can be found in DNA, RNA, and the parts of nucleotides that provide metabolic energy (like ATP). The process of photosynthesis depends heavily on phosphorus. Stunted growth is one of phosphorus deficiency's signs (Khairuna, 2019). The amount of P_2O_5 in cow manure is 0.2%, compared to 1.3% in chicken manure (Simanungkali et al., 2006). The concentration of secondary metabolism in the form of tannins, phenolic compounds, and flavonoids is influenced by the difference in the P nutrient content between these two types of manures. Environmental factors affect the levels of flavonoids and other phenolic compounds in plants, which vary among parts, tissues, and ages of plants. These include air temperature, nutrient availability, water availability, and atmospheric CO₂ concentrations (Amelia, 2015).

Antioxidants

The antioxidant activity analysis produced different IC_{50} values depending on the type of organic fertilizer used (Table 6). The IC_{50} decreased as the fertilizer dose increased. A concentration known as IC_{50} is capable of reducing 50% of DPPH free radicals. The greater the antioxidant activity, the lower the IC_{50} value (Widyasanti et al., 2016). Antioxidants are compounds that can absorb or neutralize free radicals, thereby preventing certain diseases caused by free radicals (Parwata, 2016).



The treatments of cow manure, as shown in Table 6 resulted in lower yields than chicken manure. The antioxidant activity of the dried rhizome samples was higher than that of the fresh rhizomes. The highest antioxidant activity was produced by cow manure at a dose of 60 t/ha, with an IC₅₀ value of 9.52 ppm for fresh rhizome and 8.6 ppm for dry rhizome. At a dose of 20 t/ha in both fresh and dry rhizome conditions, cow manure had a lower IC₅₀ value than chicken manure. For fresh rhizomes, the treatment without fertilizer produced an IC₅₀ value of around 53.58 ppm, and for dry rhizomes, it was around 40.91 ppm.

Widyasari *et al.* (2016) claimed that the antioxidant activity in bangle rhizomes is incredibly powerful. Wartano *et Al.*(2016) classified antioxidants into five groups based on their IC₅₀ values: 50 very strong, 50-100 strong, 101-250 moderate, 251-500 weak, and >501 inactive . Except for the treatment without fertilizer in fresh rhizome conditions, the IC₅₀ value in bangle rhizome in all treatments gave a value of 50 and included a very potent antioxidant. The high secondary metabolic compounds found in the bangle rhizome are inextricably linked to the high antioxidant activity. Secondary plant metabolites like flavonoids and phenolics play a part in antioxidant activity. More phenolic compounds will have a higher level of antioxidant activity (Amelia, 2015).

Conclusion

A cow manure dose of 60 t/ha is the best dose for plant growth, with an average height increase of 42.78 cm, an increase in the number of leaves of 116.65 pieces, and an increase in the number of tillers of 14.45. A dose of 60

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Acknowledgements

Please insert acknowledgements to those who funded and assisted in implementing this study/research. It would be better if we got used to acknowledging anyone who has helped us

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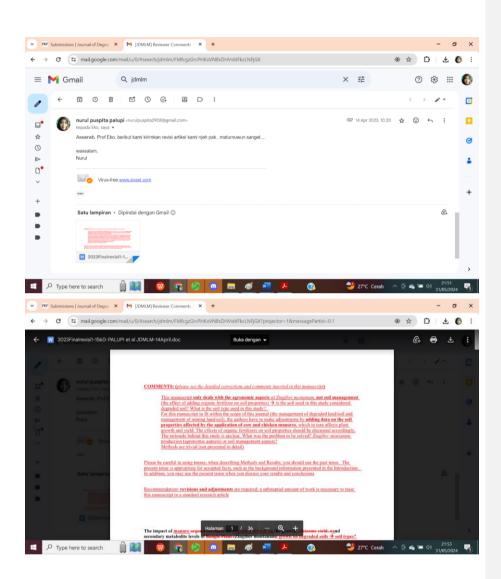
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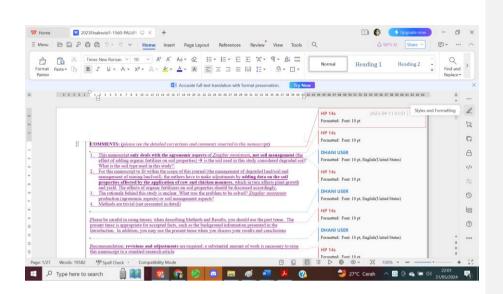
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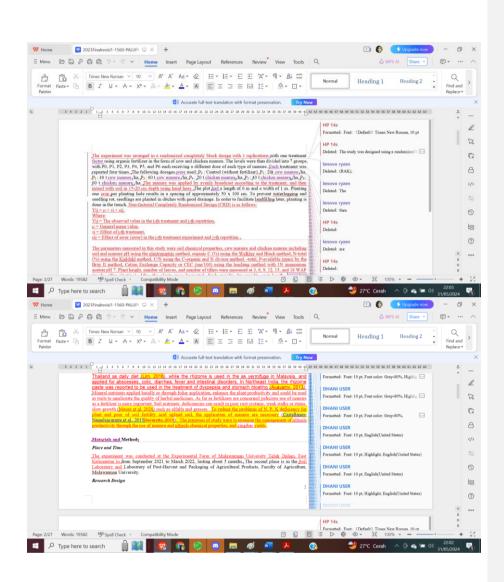




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		manure 20 (/ha), P5 (chicken manure 40 (/ha), and P6 (chicken manure 60 (/ha), and then repeated four time times of incubations. The results showed that the application of manure improved soil chemical character	eristics,	HANIUSER		
		and affected the yield of zingiber montanum. The addition of chicken manure 60 tha has the effect of increasing CEC of goil and cow manure 60 tha has the effect of increasing CEC of goil. And indicated that	a cow	ormatted: Fost: 10 pt, English(United States)		
		manure dose of 60 that is the best dose for plant growth, as measured by an average height increase of 42. an increase in the number of leaves (116.65 pieces), and an increase in the number of tillers (14.45 pieces).	a) at 18	P 14s munited: Fent: 10 pt		2
		weeks after planting. A dose of 60 tha of chicken manure produced the best root length of 41.03 cm. The h dry and wet weight yields, of about 179.75 g and 822 g, respectively, came from the rhizome weight of	of cow	HANIUSER		C
		manure at a dose of 60 tha. The highest secondary metabolic levels in each parameter arear found rhizomes (phenolic 202.79 mg/L, flavonoid 181.91 mg/L, and tannin 5406.33 mg/L), and wer thi (phenolic 778.56 mg/L, flavonoid 104.39 mg/L) with the highest tannin compound at around 4144.38m	izomes Fo	ormatted: Font: 10 pt, English(United States)		Ê
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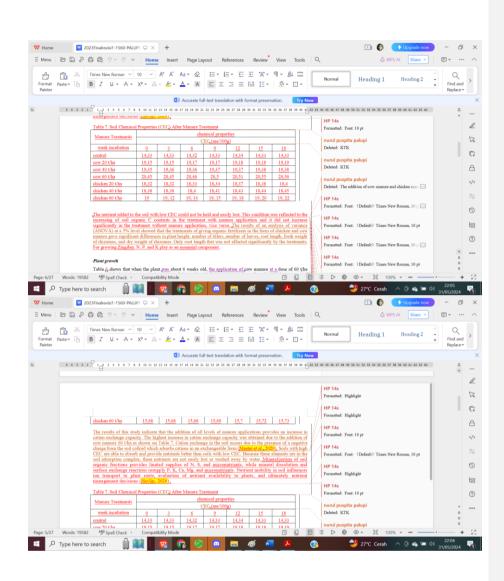
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	variance (ANOVA) with a 5% confidence level, followed by a 5% level DMRT (Duncan Multiple Range Test) to detect significant differences among treatment, - The results of the secondary metabolic level identification	1	
	and antioxidant activity tests were analyzed qualitatively using the descriptive method. Comparing phytochemical compound levels in each treatment was based on secondary metabolism levels. Antioxidant		
	activity and assessed by comparing the IC30 values in each treatment. A spectrophotometry method, was used lenovo ryzen		
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	The results of manure analysis (Table 1) showed that the organic C content was relatively high (29,5%) for cow		
	60.63% respectively. N total are about 2.08% for cow manure and 1.37% for chicken manure, with C/N ratio 14.21 and 29.57 respectively. The manure contained some micro elements required by plant. Therefore, the		
	guality of manure used in this study was high. Manue could improve soil chemical and physical properties in the study of the maturity of manue (<u>La</u> et al. 2019, Animal manue in the study of the maturity of		
	contains a lot of nitrogen as well as metallic minerals like magnesium, potassium, and calcium. The primary Deleted: benefit of manure is that it preserves the physical structure of the soil, allowing roots to grow properly, as well as		
	supporting the biological and chemical properties of the soil (Melssand et al., 2019). Therefore, the purpose of fertilization is to replenish lost nutrients and increase the amount of nutrients available to plants, thereby increases no data anality and analarity to available trades and maintain nutrient and analarity and analarity to available the plants and analarity and available to plants.		
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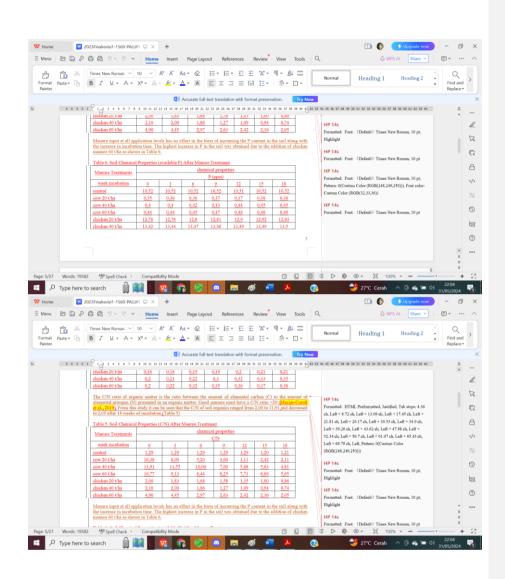


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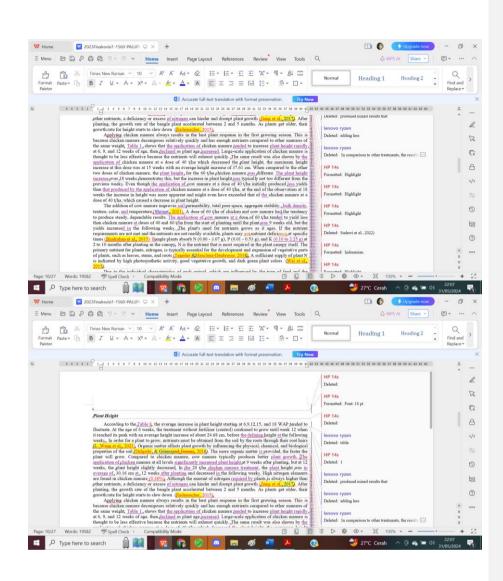
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	Table & shows that the highest number of tillers <u>was</u> found at a dose of 60 tha of chicken manure, with an average of 1.65 tillers at 6 weeks after planting. At the age of 9 weeks after planting, a control with an average		
	of about 2.55 tillers produced number of tillers, that were not significantly different from chicken manure 20 that		
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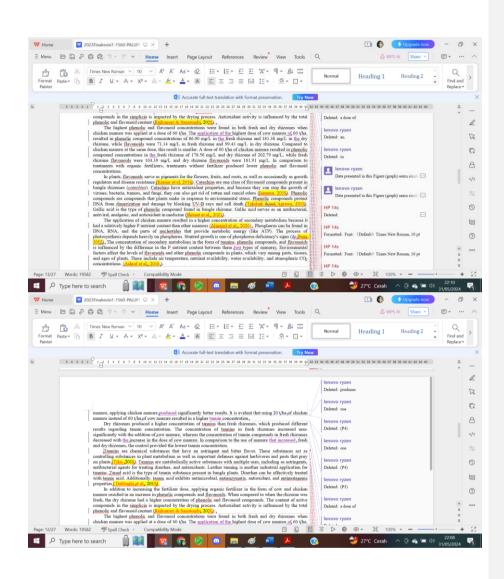


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	leaves, root length, fresh weight of rhizomes, and dry weight of rhizomes. Only root length that was not affected significantly by the treatments.	Deleted: is		
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	were strongly affected by the differences in incubation time and manure rate. There were significant differences between the incubation time on pH H:O, pH KCI, total N, exchangeable acid and base cations, CEC, BS (P<0.001),	Deleted: is		
	and organic C (P<0.01). Some parameters (e.g., pH H:O, pH KCI, organic C, exchangeable bases, and base saturation) showed statistically high values and concentrations at the first two weeks, which decreased at the next four and six	lenovo ryzen Deleted: produces		
	weeks. The increment in incubation time seemingly exhibited an inconsistent effect on the soil. Addition et al. (2020), were reported that utilization of organic manure to meet crop nutrient requirement will be an unavoidable practice			
	to enhance sustainable agriculture, this is because, the physical, chemical and biological properties of soil is generally improved by the addition of organic manures which in turn enhances crop productivity and maintains	Deleted: wet		
	the quality of crop produce. Poultry litter treatments were positively correlated with greater soil fertility levels, as well as higher crop yield and soil biodiversity. These results underscore linkages between manure additions	lenovo ryzen		
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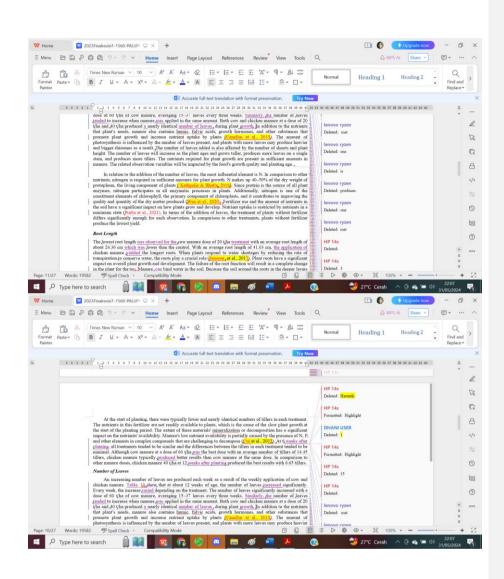
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	Bayonoids and phenolics play a part in antioxidant activity. More phenolic compounds will have a higher level	Formatted: Highlight	
	of antioxidant activity [Toluma et al., 2017],	HP 14s	
	Conclusion	Deleted: Amelia, 2015)	
	A cow manure dose of 60 that is the best dose for plant grath, with an average height increase of 42.78 cm, an increase in the number of leaves of 116.65 pieces, and an increase in the number of tillers of 14.45. A dose of 60	HP 14s Formatted: Font: 10 pt	
	that of chicken manure produced the best root length of 41.03 cm. The weight of the rhizomes revealed that the application of cow manure at a dose of 60 tha resulted in the highest yields of dry weight and wet tweight, which were about 179.75 g and 82.2 g, respectively. A chicken manure dose of 60 tha results in the highest secondary	lenovo ryzen	
	were about 179.79 and 6.2 g, respectively. A cincken manue dose of 60 (marestinks in the inginest secondary) metabolic rate in each parameter, including dry rhizome (phenolic 202.79mg/L, flavonoid 181.91mg/L, and tannin \$406.33mg/L\$) and wet rhizome (phenolic 178.56mg/L, flavonoid 104.39mg/L\$), while a chicken manure	Deleted: ons	
	dose of 40 t/ha results in the highest tamin Giving chicken manure at a dose of 60 t/ha produced very strong antioxidant results at 9.52 ppm wet rhizome and 8.06 ppm dry rhizome, according to the antioxidant results.	HP 14s Deleted: o	
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	This study was funded by Ministry of Education. Culture, Research and Technology Republic of Indonesia as part of the scheme Higher Education Excelence Applied Research (Grant no. 030/E5/PG.0200.PT/2022 for Swandari Paramita).	Deleted: ons	*
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	and ages of plants. These include air temperature, nutrient availability, water availability, and atmospheric CO2		
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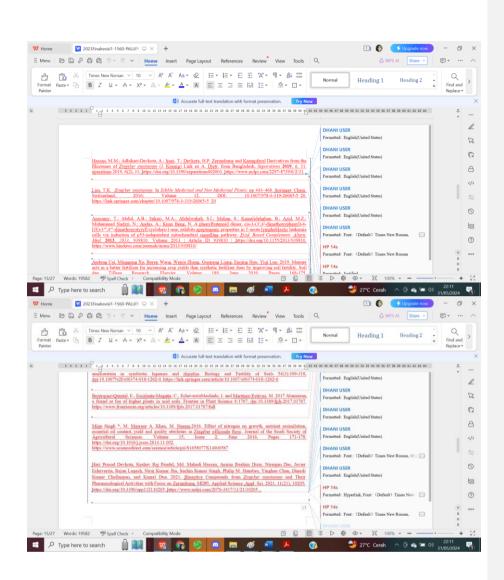
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	better outcomes than other dows of chicken manuer. The amount and timing of fertilizer applied can simplified and the second sec			
	eropy yields, among other things. Organic matter plays a crucial role in soil health because it can create stable soil aggregates, increase soil fertility, and serve as a source of energy for organisms [Magded] 2013, The application of manue enhances the chemical, physical, and biological properties of the soil, increase		4	
	crop yield, and improves crop quality (Di. et al. 2020). High organic matter soits have beneficial microorganisms that encourage the breakdown of organic matter and release inorganic matter and release inorganic matter and the second secon		1	
	available for plant uptake, Organic fertilizers can help to create ideal conditions in the soil for microorganisms that are help in the conditional of the source of the s		1	
	despite not being the best does for bangle thizone weight yield. As they ensure the best numeries management for plants, such fertilizers should be used promptly to partially replace chemical fertilizers (<u>de Armijo Guinaraes et</u>)			
	al. 2019).			
	Secondary metabolic levels (phenolic compounds, flavonoids and tannins) The results of laboratory analysis found that the positive bangle rhizome contains compounds in the form of		0	
	phenolis, tamins and flavonoids. These compounds respond differently to the concentration of granic fertilizer appled in the form of cow and chicken manures. According to Table 12, the amount of tamin compounds		1	
	increased as manure dosage, cross. The application of chicken manure of, cow manure with three doses of 20, 40, and 60 talways increased the tunin concentration in the rhizone as the dose increased. When compared to cow		ę	
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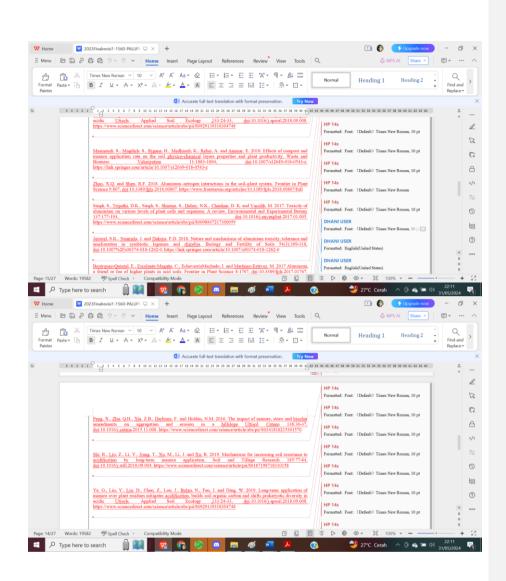
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	development. Up until the soil reaches its critical water potential, plant roots expand into moist soil and draw	Deleted: Solichatur		
	water (Sisouvanh, et al., 2021). The looseness of the solic an promote root development. Strong roots will make it simpler for plants to absorb nutrients and water	HP 14s		
	Rhizome fresh Weight	Deleted: 05		
	Plant biomass is a common parameter used to study plant growth, When plant nutrient requirements are met, yields will be optimal (Timung, 2018). The rhizome of the bangle plant is the part that is most advantageous for	Dalatak Wat		
	cultivation. One could also argue that this rhizome's fresh weight is a crucial factor in determining how well bangle plant cultivation is going. The cultivation method is better and more productive the more weight of the			
	wer thizone can be obtained. According to the results of the application of the organic fertilizers at the appendix the set of the vecks, cow manure at a dose of 60 tha produced the highest fresh weight of rhizones, averaging 822 g/plant and chicken manure at a dose of 20 tha produced the lowest fresh weight of rhizones, averaging 393 25 g/plant	Deleted: The fresh weight of the plant describes the w		
	and encoder manufer at a cose of 20 (nh produced the lowest <u>press</u>) weight of mizonest, <u>averaging 595, 25 (p)</u> Manufer increases crop yield and quality while also enhancing the chemistry, physical characteristics, and biological properties of the soil (<u>Mater al., 2021</u>). Data presented in Table 11, demonstrate that the yield of fresh	HP 14s		
	weight of thizomes increased with increasing manure dosage. The physical condition of the soil must support plant growth in addition to a supply of adequate and balanced nutrients (<u>FI-Ramady, etal.</u> 2015). These soil			
	aggregates will keep the soil in a loose condition (http://www.2015). Cow manure will enhance the physical characteristics of the soil. Improved soil physical characteristics include things like increased permeability, total	1 HP 145		
	pore space, aggregate stability, <u>bulk density</u> , texture, color, <u>and temperature</u> (<u>Agbede</u> , 2021). Intensive tillage affects the physical properties of the soil. Low organic matter soils will have more sever damage to the acide cattering (<u>Mender</u> , 2015). When the coll does not reacide accent works and have and have a sever damage to the acide cattering (<u>Mender</u> , 2015).	P HP 14s	0 ∓	
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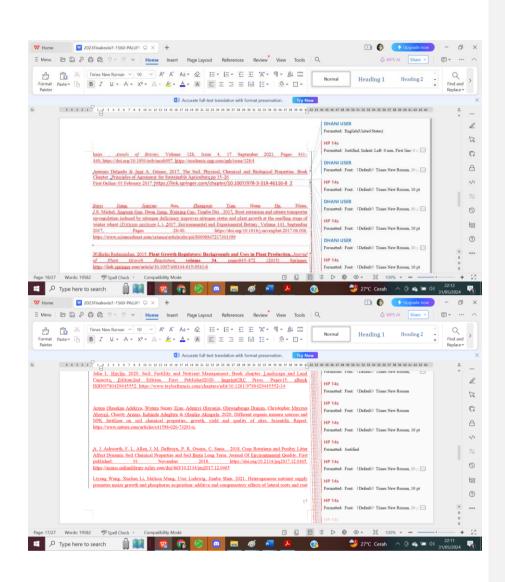
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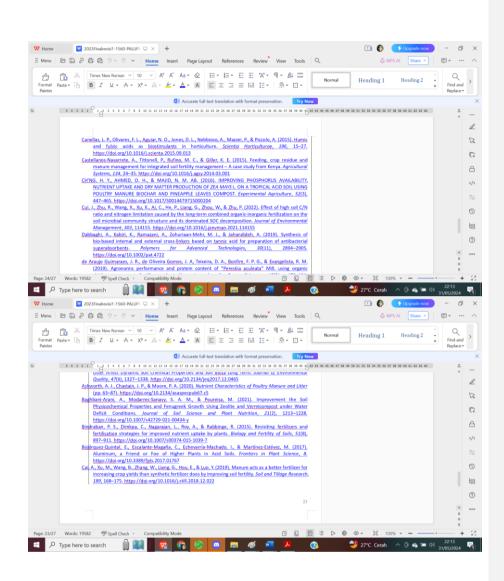
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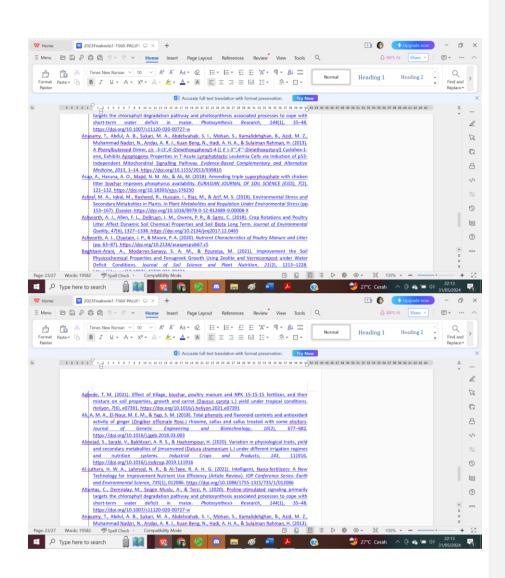
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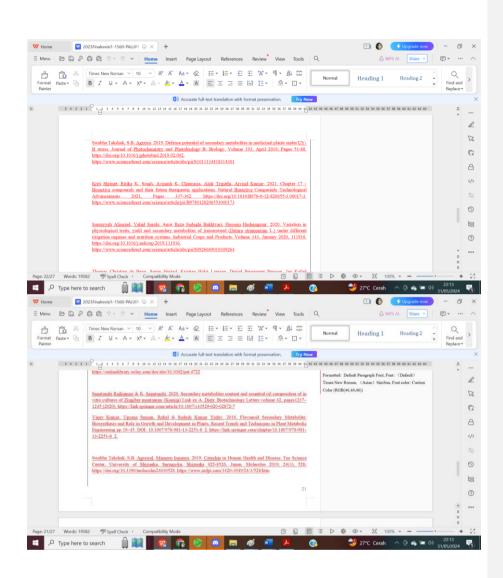
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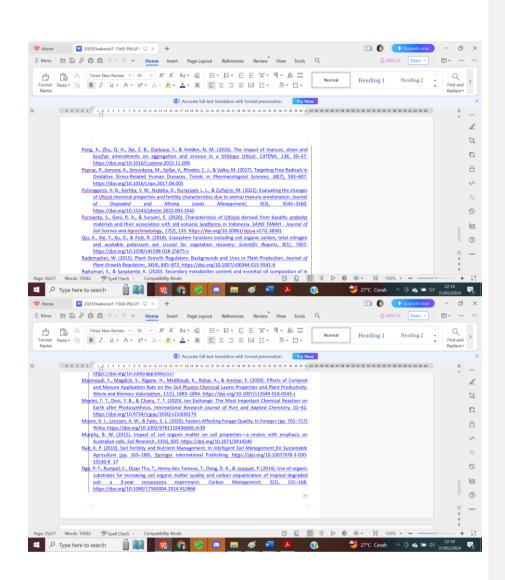
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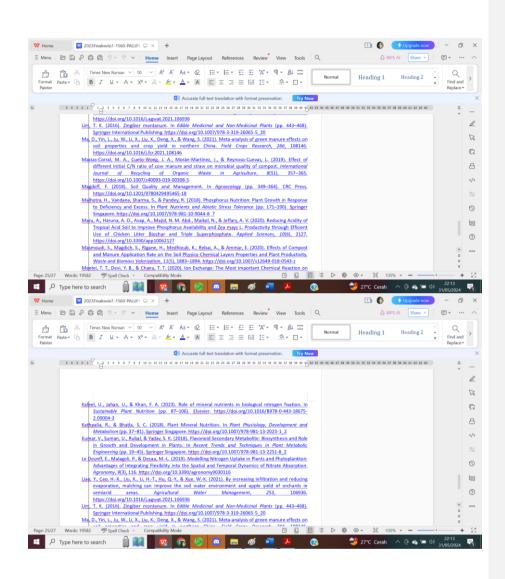
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Setelah dilakukan revisi :

COMMENTS: (please see the detailed corrections and comments inserted in this manuscript)

- 5. This manuscript only deals with the agronomic aspects of *Zingiber montanum*, not soil management (the effect of adding organic fertilizer on soil properties) → is the soil used in this study considered degraded soil? What is the soil type used in this study?.
- 6. For this manuscript to fit within the scope of this journal (the management of degraded land/soil and management of mining land/soil), the authors have to <u>make adjustments</u> by adding data on the soil properties affected by the application of cow and chicken manures, which in turn affects plant growth and yield. The effects of organic fertilizers on soil properties should be discussed accordingly,

- 7. The rationale behind this study is unclear. What was the problem to be solved? Zingiber montanum production (agronomic aspects) or soil management aspects?
- 8. Methods are trivial (not presented in detail)

Please be careful in using tenses; when describing Methods and Results, you should use the <u>past tense</u>. The <u>present tense</u> is appropriate for accepted facts, such as the background information presented in the Introduction. In addition, you may use the <u>present tense</u> when you discuss your results and conclusions

Recommendation: revisions and adjustments are required; a substantial amount of work is necessary to raise this manuscript to a standard research article

The impact of manure on degraded ultisols on the growth and secondary metabolite levels of Zingiber montanum

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Abstract

Acid upland soil in Indonesia has a potential for agricultural development but it has constraints low of organic C , N, P and available P as well as the soil chemical properties have been degraded. The use of manure was an alternative to improve land productivity and crop yields. The objective of the study was to examine the effects of manure on chemical properties of ultisols, yield and secondary metabolic of zingiber montanum. The experiment was carried out at Research Laboratory Teluk Dalam in 2022 using randomized completely block design. The treatments are consisting of organic fertilizer in the form of cow and chicken manure, and the levels were namely P0 (control), P1 (cow manure 20 t/ha), P2 (cow manure 40 to/ha), P3 (cow manure 60 t/ha), P4 (chicken manure 20 t/ha), P5 (chicken manure 40 t/ha), and P6 (chicken manure 60 t/ha), and then repeated four times in 7 times of incubations. The results showed that the application of manure improved soil chemical characteristics and affected the yield of zingiber montanum. The addition of chicken manure 60 t/ha has the effect of increasing N and P of soil and cow manure 60 t/ha has the effect of increasing CEC of soil. And indicated that a cow manure dose of 60 t/ha is the best dose for plant growth, as measured by an average height increase of 42.78 cm, an increase in the number of leaves (116.65 pieces), and an increase in the number of tillers (14.45 pieces) at 18 weeks after planting. A dose of 60 t/ha of chicken manure produced the best root length of 41.03 cm. The highest dry and wet weight yields, of about 179.75 g and 822 g, respectively, came from the rhizome weight of cow manure at a dose of 60 t/ha. The highest secondary metabolic levels in each parameter were found in dry rhizomes (phenolic 202.79 mg/L, flavonoid 181.91 mg/L, and tannin 5406.33 mg/L), and wet rhizomes (phenolic 178.56 mg/L, flavonoid 104.39 mg/L) with the highest tannin compound at around 4144.83mg/L in chicken manure dose of 40 t/ha. According to the antioxidant results, providing chicken manure at a dose of 60 t/ha resulted in very strong antioxidant results in each of the wet and dry rhizomes, which were respectively 9.52 ppm and 8.06 ppm.

Keywords: degraded soil, manure, soil chemical, ultisols

Introduction \rightarrow in this section, the existing problems of the soils used for growing Zingiber must be described

Ultisols is a very acid soil with soil pH ranges from 4.2 to 4.3, due to the relatively high rainfall (> 2,000 mm year-1), the soil bases such as Ca, Mg, K and Na cations are released and quickly leached from the soil. With

liming and fertilization being common solutions to overcome this problem (Purwanto, et.al, 2020) however, studies on Ultisol as zingiber growing media are still rare. Ultisols, in contrast, show younger characteristics, containing expandable 2:1 clay minerals. They contribute to higher CEC and the dominance of Al3+ for exchangeable sites, resulting in lower soil pH. Thus, it is well known that soil acidity can inhibit nitrification (Shibata et al. 2017). Ultisols commonly have low base saturation, acidic soil reactions, and elevated Al3+ saturations. However, a distinct Ultisol is found in East Kalimantan with extremely high aluminum saturation could cause severe toxicity to the plant. Al3+ competition potentially enhances the desorption and leaching process of nutrient cations from the soil exchange complex, also hampering their absorption in the plant root area (Singh et al., 2017; Jaiswal et al., 2018; Zhao and Shen, 2018). Low pH exacerbates that effect by increasing the micronutrients/trace elements availability (e.g., Fe, Mn, Cu, and Zn), which is potentially toxic for plants. This condition, combined with other soil properties, may lead to nutrient deficiency, resulting in limited plant growth and development and a decline of plant productivity (Bojórquez-Quintal et al., 2017). Beside of nutrient deficiencies, the upland ultisols soil contains low organic matter, high soil bulk density (BD), low of total pores space, soil permeability and available water. Animal manure as an organic matter source plays a vital role in improving soil properties, the quality that is crucial in mitigating the adverse effect of chemical fertilizer and combating land degradation. Animal manure application demonstrated positive effects on Ultisols physical, chemical, and biological properties, particularly in alleviating soil acidity and Al toxicity (Zhou et al., 2013; Ngo et al., 2014; Ch'ng et al., 2015; Peng et al., 2016; Shi et al., 2019; Ye et al., 2019), a valuable source of key nutrients including nitrogen (N), phosphorus (P), and potassium (K) as well as certain micronutrients. Adding manure to soil impacts the chemical aspect of soil quality. Manure increases plant productivity, soil organic matter and structure, water infiltration and holding capacity, and over time, can reduce sediment loss and erosion with application and incorporation into soils, which also had advantageous effects on plant growth and development (Masmoudi et al., 2018; Pandey et al., 2021). Zingiber montanum (Syns: Amomum cassumunar (Roxb.) Donn, Amomum montanum J. König, Amomum xanthorhiza Roxb. Steud., Cassumunar ex roxburghii Colla, Jaegera montana (J. König) Giseke, Zingiber anthorrhiza Horan., Zingiber cassumunar Roxb., Zingiber cassumunar var. palamauense Haines, Zingiber cassumunar var. subglabrum Thwaites, Zingiber cliffordiae Andrews, Zingiber luridum Salisb., Zingiber montanum (J. König Retz.) Theilade, Zingiber purpureum Roscoe, Zingiber ex purpureum var. palamauense (Haines) K.K. Khanna, Zingiber xantorrhizon Steud.) (WF0, 2021) is commonly known as "Banada" in Bangladesh, "Phlai" in Thailand, "Jangliadrak" in India, and "Bangle" in Malaysia. It is reported to be native to Southeast Asia and has been extensively planted in Thailand, Malaysia, and Indonesia (Hassan et al. 2019). The rhizomes of this plant are used in traditional medicines for the treatment of constitution. dyspepsia, gastritis, stomach bloating and stomach-ache. Various parts of Z. montanum are used in Thailand as daily diet (Lim, 2016), while the rhizome is used in the as vermifuge in Malaysia, and applied for abscesses, colic, diarrhea, fever and intestinal disorders. In Northeast India, the rhizome paste was reported to be used in the treatment of dyspepsia and stomach bloating (Anasamy, 2013). Mineral nutrients applied basally or through foliar application, enhance the plant productivity and could be used as tools to ameliorate the quality of herbal medicines. As far as fertilizers are concerned judicious use of manure as a fertilizer is more important. Soil nutrients deficiencies can result in poor root systems, weak stalks or stems, slow growth (Moore et al, 2020) such as alfalfa and grasses. To reduce the problems of N, P, K deficiency for plant and poor of soil fertility acid upland soil, the application of manure are necessary (Navarette, 2015). The purposes of study were to examine the management of ultisols productivity through the use of manure and ultisols chemical properties, and zingiber yields.

Materials and Methods

Place and Time

The experiment was conducted at the Experimental Farm of Mulawarman University Teluk Dalam, East Kalimantan in from September 2021 to March 2022, lasting about 5 months. The second place is in the Soil Laboratory and Laboratory of Post-Harvest and Packaging of Agricultural Products, Faculty of Agriculture, Mulawarman University.

Research Design

The experiment was arranged in a randomized completely block design with 3 replications with one treatment factor using organic fertilizer in the form of cow and chicken manure. The levels were then divided into 7 groups, with P0, P1, P2, P3, P4, P5, and P6 each receiving a different dose of each type of manure. Each treatment was repeated four times. The following dosages were used: P₀ : Control (without fertilizer), P₁ : 20t cow manure /ha, P₂ : 40 t cow manure /ha, P₃ : 60 t cow manure /ha, P₄ : 20 t chicken manure /ha, P₅ : 40 t chicken manure /ha, P₆ : 60 t chicken manure /ha. The manure was applied by evenly broadcast according to the treatment, and then mixed with soil in 15-20 cm depth using hand hoes. The plot had a length of 6 m and a width of 1 m. Planting one crop per planting hole results in a spacing of approximately 50 x 100 cm. To prevent waterlogging and seedling rot,

seedlings are planted in ditches with good drainage. In order to facilitate landfilling later, planting is done in the trench. Non-factorial Completely Randomized Design (CRD) is as follows: $Y_{ij} = \mu + \tau_i + \epsilon_{ij}$.

 $Y_{1j} = \mu + \tau$ Where:

- Yij = The observed value in the i-th treatment and j-th repetition,
- $\mu =$ General mean value,
- $\tau i = Effect of i-th treatment,$
- $\epsilon ij = Effect of error (error) in the i-th treatment experiment and j-th repetition.$

The parameters measured in this study were soil chemical properties, cow manure and chicken manure including soil and manure pH using the electrometric method, organic C (%) using the Walkley and Black method, N-total (%) using the Kjeldahl method, C/N using the C-organic and N divisor method. -total, P-available (ppm) by the Bray II method, Cation Exchange Capacity or CEC (me/100) using the leaching method with 1N ammonium acetate pH 7. Plant height, number of leaves, and number of tillers were measured at 3, 6, 9, 12, 15, and 18 WAP (weeks after planting). After the plants were harvested, fresh weight, dry weight, root length, secondary metabolic, and antioxidant levels were measured.

Laboratory measurement

Soil analyses were carried out in the Soil Science Laboratory, Faculty of Agriculture, Mulawarman University. The initial soil examination soil reaction was determined using soil to water mixture of 1:1. Organic carbon was extracted using the Walkey and Black method. Total N was extracted using the Kjeldahl method. Exchangeable aluminum was extracted using KCl 1 N. Cation base, and cation exchangeable capacity/CEC were extracted using an ammonium acetate (NH4OAc) solution pH 7.0. Clay to CEC ratio/CCR was calculated by dividing CEC by clay percentage. Since the observed soil pH was acidic, the ECEC was applied as the CEC reference for calculating the base and individual saturation.

Data Analysis

Soil data's were analyzed descriptively while the crop data's were analyzed using the SAS Systems for Linier Models, v.6.12 for windows (Ramon et al. 1992). Data were analyzed by analysis of variance and followed by Duncan Multiple Range Test (DMRT) at 5% significance level. The financial effectiveness of each treatment was calculated by input-output farming and B/C ratio. The data obtained were subjected to the analysis of variance (ANOVA) with a 5% confidence level, followed by a 5% level DMRT (Duncan Multiple Range Test) to detect significant differences among treatments .. The results of the secondary metabolic level identification and antioxidant activity tests were analyzed qualitatively using the descriptive method. Comparing phytochemical compound levels in each treatment was based on secondary metabolism levels. Antioxidant activity was assessed by comparing the IC50 values in each treatment. A spectrophotometry method was used for all of the parameters of the secondary metabolic level test.

Results

Manure Quality

The results of manure analysis (Table 1) showed that the organic C content was relatively high (29.55%) for cow manure and 40.51% for chicken manure, the water contents was characterized at moderate level (72,9% and 60.63% respectifely). N total are about 2,08% for cow manure and 1,37% for chicken manure, with C/N ratio 14,21 and 29,57 respectively. The manure contained some micro elements required by plant. Therefore, the quality of manure used in this study was high. Manure could improve soil chemical and physical properties effectively, and the plant growth was affected by the maturity of manure (Cai et al, 2019). Animal manure contains a lot of nitrogen as well as metallic minerals like magnesium, potassium, and calcium. The primary benefit of manure is that it preserves the physical structure of the soil, allowing roots to grow properly, as well as supporting the biological and chemical properties of the soil (Melsasail et al., 2019). Therefore, the purpose of fertilization is to replenish lost nutrients and increase the amount of nutrients available to plants, thereby increasing plant quality and quantity by gradually release nutrients into the soil solution and maintain nutrient balance for healthy growth of crop plants. They also act as an effective energy source of soil microbes which in turn improve soil structure and crop growth (Shaji et al. 2020).

Tabel 1. Chemical Characteristic of manure

Manure	chemical properties
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Commented [12]: how did you analyze them? (what methods?)

	pН	C (%)	N (%)	C/N	P (ppm)	water content (%)
Cow	6,5	29,55	2,08	14,21	0,17	72,9
Chicken	6,4	40,51	1,37	29,57	0,67	60,63

As a function of soil chemistry, organic manure could provide some of soil CEC that was important to hold a given inorganic fertilizers and soil buffering capacity, so that the crops could avoid from the pressure of soil acidity (Shi et al, 2019). The use of organic materials increased the availability of some nutrients and improved the efficiency of P absorption by crops because in the process of organic matters decomposition humic acid and fulfat acid (polyelectrolite) were produced that had an ability to bind Al and Fe in the soil (Al-Juthery et al, 2021). To eliminate P fixation in the soil, the active anion of organic manure formed a chelate bond with Si-Al-OOCR (Alofan). The higher the carboxyl and fenolic compounds in organic matters the higher the ability of organic matters to realease AlHPO4 bonds so the P nutrient became more available for plant (Ch'ng et al 2014; Asap et al, 2018; Maru et al, 2020). By increasing of organic matter contents in the soil, the N total and N mineralization, soluble P, exchangeable K, N uptake by plants and soil water content could be increased (Kafeel et al, 2023).

Soil Chemical Properties

The effect of manure to the soil chemical properties shows on Table 2, that the initial soil pH (before planting) is 5,62 and increased until 4,21 after manure applications. A significant decrease in soil acidity was obtained due to the addition of chicken manure 60 t/ha.

Manure Treatments	chemical properties										
Manufe Treatments		pH									
week incubation	0	3	6	9	12	15	18				
control	5,62	5,62	5,62	5,61	5,62	5,62	5,62				
cow 20 t/ha	6,4	6,2	6	5,80	5,7	5,7	5,6				
cow 40 t/ha	6,5	6,4	6,3	5,9	5,7	5,5	5,4				
cow 60 t/ha	6,8	6,6	6,4	6,6	6,2	6	5,8				
chicken 20 t/ha	5,83	5,6	5,4	5	4,83	4,7	4,51				
chicken 40 t/ha	6,04	6	5,8	5,04	4,74	4,9	4,8				
chicken 60 t/ha	6,08	5,43	5,08	4,76	4,77	4,08	4,21				

Table 2. Soil Chemical Properties (pH) After Manure Treatment

The addition of manure has an effect on reducing soil organic C at all levels of addition of manure. A significant decrease in organic C occurred with the addition of chicken manure 20 t/ha as shown in Table 3. In soil ecosystems, C-organic is an important component that influences soil properties to support plant growth, namely as a source of energy for soil organisms and a trigger for nutrient availability for plants (Qiu et al 2018).

Table 3. Soil Chemical Properties (Organic C) After Manure Treatment

Manure Treatments	chemical properties										
Manufe Treatments		Organic C (%)									
week incubation	0	3	6	9	12	15	18				
control	0,18	0,18	0,18	0,18	0,18	0,18	0,17				
cow 20 t/ha	0,83	0,8	0,78	0,64	0,56	0,46	0,4				
cow 40 t/ha	1,31	1,27	1,2	1,19	1,08	1,07	1,01				
cow 60 t/ha	1,4	1,37	1,35	1,32	1,31	1,31	1,3				
chicken 20 t/ha	0,36	0,33	0,32	0,3	0,27	0,21	0,18				
chicken 40 t/ha	0,42	0,42	0,41	0,38	0,35	0,31	0,26				
chicken 60 t/ha	0,98	0,98	0,95	0,92	0,87	0,8	0,78				

Application of all levels of manure resulted in an increase in the N content in Ultisol soil as shown in Table 4. The best increase in N content in Ultisol was obtained due to the addition of chicken manure 60 t/ha.

Manure Treatments	chemical properties									
intuiture Treutitionits				N (%)						
week incubation	0	3	6	9	12	15	18			
control	0,14	0,14	0,14	0,14	0,14	0,15	0,14			
cow 20 t/ha	0,08	0,1	0,15	0,16	0,18	0,19	0,19			
cow 40 t/ha	0,11	0,11	0,12	0,17	0,19	0,19	0,21			
cow 60 t/ha	0,13	0,15	0,16	0,16	0,17	0,19	0,23			
chicken 20 t/ha	0,18	0,18	0,19	0,19	0,2	0,21	0,21			
chicken 40 t/ha	0,2	0,21	0,22	0,3	0,32	0,33	0,35			
chicken 60 t/ha	0,2	0,22	0,32	0,35	0,36	0,37	0,38			

Table 4. Soil Chemical Properties (Organic N) After Manure Treatment

The C/N ratio of organic matter is the ratio between the amount of elemental carbon (C) to the amount of elemental nitrogen (N) presented in an organic matter. Good manure must have a C/N ratio <20 (Macias-Corral et al 2019). From this study it can be seen that the C/N of soil organics ranged from 2,00 to 11,91 and decreased to 2,05 after 18 weeks of incubation (Table 5)

Table 5. Soil Chemical Properties (C/N) After Manure Treatment

Manure Treatments	chemical properties										
Manure Treatments		C/N									
week incubation	0	3	6	9	12	15	18				
control	1,29	1,29	1,29	1,29	1,29	1,20	1,21				
cow 20 t/ha	10,38	8,00	5,20	4,00	3,11	2,42	2,11				
cow 40 t/ha	11,91	11,55	10,00	7,00	5,68	5,63	4,81				
cow 60 t/ha	10,77	9,13	8,44	8,25	7,71	6,89	5,65				
chicken 20 t/ha	2,00	1,83	1,68	1,58	1,35	1,00	0,86				
chicken 40 t/ha	2,10	2,00	1,86	1,27	1,09	0,94	0,74				
chicken 60 t/ha	4,90	4,45	2,97	2,63	2,42	2,16	2,05				

Manure input at all application levels has an effect in the form of increasing the P content in the soil along with the increase in incubation time. The highest increase in P in the soil was obtained due to the addition of chicken manure 60 t/ha as shown in Table 6.

Table 6. Soil Chemical Properties (available P) After Manure Treatment

Manure Treatments		chemical properties									
Manufe Treatments		P (ppm)									
week incubation	0	3	6	9	12	15	18				
control	10,52	10,52	10,52	10,52	10,51	10,52	10,52				
cow 20 t/ha	0,35	0,36	0,36	0,37	0,37	0,38	0,38				
cow 40 t/ha	0,4	0,4	0,42	0,43	0,44	0,45	0,45				
cow 60 t/ha	0,44	0,44	0,45	0,47	0,48	0,48	0,49				
chicken 20 t/ha	12,78	12,78	12,8	12,81	12,9	12,92	12,93				
chicken 40 t/ha	13,42	13,44	13,47	13,48	13,49	13,49	13,5				
chicken 60 t/ha	15,68	15,68	15,68	15,69	15,7	15,72	15,73				

The results of this study indicate that the addition of all levels of manure applications provides an increase in cation exchange capacity. The highest increase in cation exchange capacity was obtained due to the addition of cow manure 60 t/ha as shown on Table 7. Cation exchange in the soil occurs due to the presence of a negative

charge from the soil colloid which adsorbs cations in an exchangeable form (Meetei et al. 2020). Soils with high CEC are able to absorb and provide nutrients better than soils with low CEC. Because these elements are in the soil adsorption complex, these nutrients are not easily lost or washed away by water. Mineralization of soil organic fractions provides limited supplies of N, S, and micronutrients, while mineral dissolution and surface exchange reactions resupply P, K, Ca, Mg, and micronutrients. Nutrient mobility in soil influences ion transport to plant roots, evaluation of nutrient availability to plants, and ultimately nutrient management decisions (Havlin, 2020).

Table 7. Soil Chemical Properties (CEC) After Manure Treatment

Manure Treatments	chemical properties										
Manure Treatments		CEC (me/100g)									
week incubation	0	3	6	9	12	15	18				
control	14,33	14,33	14,32	14,33	14,34	14,33	14,33				
cow 20 t/ha	19,15	19,15	19,17	19,17	19,18	19,18	19,19				
cow 40 t/ha	19,35	19,36	19,36	19,37	19,37	19,38	19,38				
cow 60 t/ha	20,45	20,45	20,46	20,5	20,51	20,55	20,56				
chicken 20 t/ha	18,32	18,32	18,33	18,34	18,37	18,38	18,4				
chicken 40 t/ha	18,38	18,38	18,4	18,41	18,43	18,44	18,45				
chicken 60 t/ha	19	19, 12	19, 14	19, 15	19, 18	19, 20	19, 22				

The nutrient added to the soil with low CEC could not be held and easily lost. This condition was reflected to the increasing of soil organic C contents in the treatment with manure application and it did not increase significantly in the treatment without manure application, vice versa. The results of an analysis of variance (ANOVA) at a 5% level showed that the treatments of giving organic fertilizers in the form of chicken and cow manure gave significant differences in plant height, number of tillers, number of leaves, root length, fresh weight of rhizomes, and dry weight of rhizomes. Only root length that was not affected significantly by the treatments. For growing Zingiber, N, P, and K play as an essensial component.

Plant growth

Table 8 shows that when the plant was about 6 weeks old, the application of cow manure at a dose of 60 t/ha produced the best plant growth (26.16 cm), followed by chicken manure at a dose of 60 t/ha, chicken manure of 40 ts/ha, and cow manure of 40 t/ha. In comparison to the previous week, the plant's age 9 weeks after planting showed a very rapid increase in plant height. At 9 weeks after planting , the best dose was 40 t/ha of chicken manure with an average plant height addition of about 32.45 cm. The best results were obtained at week 12, with a cow manure at a dose of 60 ts/ha and theight addition of about 32.45 cm. The best results were obtained at week 12, with a cow manure at a dose of 60 ts/ha that yielded an average plant height of 37.24 cm. The application of cow manure at a dose of 20 t/ha and chicken manure at a dose of 20 t/ha and a verage plant height of 37 to weaks after planting was 60 t cow manure /ha, with an average plan height of 40.47 cm, and 38.38 cm of chicken manure. The highest dose of cow manure yielded an average plant height of 42.78 cm at 18 weeks after planting.

Number of Tillers

Table 9 shows that the highest number of tillers was found at a dose of 60 t/ha of chicken manure, with an average of 1.65 tillers at 6 weeks after planting. At the age of 9 weeks after planting , a control with an average of about 2.55 tillers produced number of tillers that were not significantly different from chicken manure 20 t/ha. The best application was 60 t/ha of cow manure with an average of 4.15 tillers. At 12 weeks after planting , the effect of manure treatment revealed that the best dose was 40 t/ha chicken manure, with an average of 6.65 tillers. This best dose did not differ significantly between chickens and cows manure at 60 t/ha or chickens manure at 20 t/ha. Cow and chicken manure at a dose of 60 t/ha at 15 weeks after planting produced the highest yields, with cow manure yielded 9.50 tillers and chicken yielded 9.00 tillers, respectively. At 18 weeks, the control did not differ significantly from the cow manure doses of 20 and 40 t/ha. The highest number of tillers was observed for the treatment of cow manure at 60 t/ha with an average of 14.45 tillers and chicken manure at 60 t/ha with an average of 13.37 tillers.

Number of Leaves

Table 10 shows that after 6 weeks of treatment with a dose of 20 t chicken manure /ha, the number of leaves were not statistically significantly different from the control but significantly different from other treatments. The best dose of 60 t/ha cow manure, was produced at around 9 weeks, with an average increase in the number of leaves of 37.95 leaves. At 12 weeks, the control showed no significant difference from cow manure of 20 and 40 t/ha, as well as chicken manure of 20 and 40 t/ha. Cow manure of 60 t/ha with an average of 52.80 leaves provided the best dose at 12 weeks after planting . The highest dose was found in cow manure at a rate of 60 t/ha in week 15, with an average of 84.55 leaves. The application of 60 t/ha cow manure produced the largest number of leaves of 116.65 leaves in the 18th week, that significantly difference from the control. However, the application of 60 t/ha coken manure increased the number of leaves y 105.80 leaves.

Rhizome root length, wet weight and dry weight

Table 11 shows that the lowest root length of 24.36 cm was obtained by the application of 20 t/ha cow manure. The control yielded root length that was not statistically different from that yielded by the application of 20 t/ha cow and chicken manure as well as the highest dose. This result indicates that applying different doses of manure had no effect on the root length of the bangle plant. The chicken manure dosage of 20 t/ha yielded the lowest bangle rhizome fresh weight of 392.35 g. While the control yielded fresh weight that was not significantly different from 20 t/ha and 40 t/ha cow and chicken manure. The fresh weight of the bangle rhizome due to the application of 40 t/ha cow manure also did not differ significantly from those from 60 t/ha chicken manure. The treatment of 60 t/ha cow manure yielded the highest rhizome fresh weight of 822.00 g that was significantly for all treatments. The lowest dry weight of bangle rhizome was shown by the cow and chicken manure treatment at a dose of 20 t/ha, respectively 86.00 g for cow manure treatment and 78.25 g for chicken manure treatment. These values were lower than that of the control, with an average of 93.75 g. The control yielded statistically insignificantly different rhizome dry weight with chicken manure at 20 and 40 t/ha, cow manure at 60 t/ha, but yielded significantly different rhizome dry weight r with the best dose of 60 t/ha cow manure with an average rhizome dry weight of 135.75 g.

Table 8. Effect of Cow and Chicken Manure on Plant Height (in cm)

Manure Treatment	Week after planting (WAP)								
(t/ha)	6	9	12	15	18				
Control	11,38 a	18,61 a	24,68 a	20,41 a	18,82 a				
Cow 20 t/ha	17,46 b	20,26 ab	25,44 a	24,02 ab	28,51 b				
Cow 40 t/ha	20,51 c	27,95 b	29,81 ab	35,57 cd	37,19 c				
Cow 60 t/ha	26,16 e	31,18 b	37,24 c	40,47 d	42,78 c				
Chicken 20 t/ha	17,36 b	27,21 b	30,16 abc	29,15 bc	28,82 b				
Chicken 40 t/ha	22,84 cd	32,45 b	34,83 bc	37,61 cd	36,37 c				
Chicken 60 t/ha	25,68 de	32,17 b	36,84 bc	38,38 d	39,22 c				

Table 9. Effect of Cow and Chicken Manure on Rhizome number of tillers (in weeks)

Manure Treatment	t Week after planting (WAP)							
(t/ha)	6	9	12	15	18			
Control	0,8 a	2,55 a	3,95 a	5,80 a	8.60 a			
Cow 20 t/ha	0,7 b	3,45 b	5,20 b	6,60 a	10.4 ab			
Cow 40 t/ha	1,7 ac	3,4 b	5,05 ab	7,35 ab	11.55b			
Cow 60 t/ha	1,6 c	4,15 b	6,10 bc	9,50 c	14.45d			
Chicken 20 t/ha	1,3 bc	3,35 ab	5,70 bc	7,40 ab	11.05b			
Chicken 40 t/ha	1,5 c	4,00 b	6,65 c	8,45 bc	12.15bc			
Chicken 60 t/ha	1,65c	3,75 b	6,05 bc	9,00 c	13.7cd			

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Commented [13]: What is the different between Rhizome height and plant height? Commented [14R13]: We mean Table 8 is Plant height not rhizome height

Manure Treatment	Week after planting (WAP)								
(t/ha)	6	9	12	15	18				
Control	4,70 a	19,60 a	35,80 a	52,25 a	77,55 a				
Cow 20 t/ha	5,55 a	25,00 ab	41,05 ab	55,65 a	83,80 a				
Cow 40 t/ha	9,65 b	28,25 abc	42,70 abc	66,00 ab	95,35 ab				
Cow 60 t/ha	10,05b	37,95 c	52,80 c	84,55 c	116,65 c				
Chicken 20 t/ha	9,20 b	26,00 ab	40,25 ab	56,85 a	81,75 a				
Chicken 40 t/ha	9,65 b	30,90 bc	43,25 abc	67,05 bc	91,35 a				
Chicken 60 t/ha	11,05b	30,45 abc	50,75 bc	79,55 bc	105,80 bc				

Table 10. Effect of Cow and Chicken Manure on number of Rhizome Leaves (in weeks)

 Table 11. Effect of Cow and Chicken Manure on Root Length and Rhizome Weight (in 18 week)

Manure Treatment (t/ha)	Root lenght (cm)	Rhizome wet weight (g)	Rhizome dry weight (g)
Control	31,90 ab	415,25 ab	93,75 ab
Cow 20 t/ha	24,36 a	444,75 ab	86,00 a
Cow 40 t/ha	35,36 b	530,00 bc	119,00 ab
Cow 60 t/ha	36,50 b	822,00 d	179,75 c
Chicken 20 t/ha	33,20 ab	393,25 a	78,25 a
Chicken 40 t/ha	38,95 b	487,50 abc	99,75 ab
Chicken 60 t/ha	41,03 b	618,75 c	134,75 bc

Notes: Based on Duncan Multiple Range Tast (DMRT) at a 5% significance level, values in the same columns that are followed by the same letter do not differ significantly.

Table 12. Secondary Metabolic Levels in Bangle Rhizome in Each Treatment (mg/L).

Condition	Manuna Traatmant (t/ha)	Level mg/L						
Condition	Manure Treatment (t/ha)	Phenolic	Flavonoid	Tannin				
	Control	31.64	23.08	2034.83				
	Cow 20 t/ha	43.18	41.55	2991.50				
	Cow 40 t/ha	77.03	64.30	3151.50				
Fresh	Cow 60 t/ha	86.90	71.14	3198.17				
	Chicken 20 t/ha	97.67	74.79	4086.50				
	Chicken 40 t/ha	107.54	78.71	4144.83				
	Chicken 60 t/ha	178.56	104.39	3861.33				
	Control	124.97	38.44	1932.33				
	Cow 20 t/ha	133.56	67.23	2504.00				
Dry	Cow 40 t/ha	148.44	68.76	3034.83				
	Cow 60 t/ha	181.38	99.43	4734.67				
	Chicken 20 t/ha	175.23	120.06	4903.00				

Chicken 40 t/ha	198.69	156.10	5088.00
Chicken 60 t/ha	202 79	181 91	5406 33

Note: The number followed by yellow denotes the best outcome in each observation variable for the flavonoid, tannin, and phenolic contents.

Tabel 13. Antioxidant based on IC50 value

Antioxidant (IC50) (mg/L)	Manure Treatment (t/ha)									
	Control		Cow		Chicken					
(8)	Collitor	20	40	60	20	40	60			
Fresh rhizome	53.58	48.55	47.36	47.14	32.73	27.42	9.52			
Dry rhizome	40.91	38.30	34.78	34.46	24.41	14.05	8.06			

Note: The smaller the IC50 value, the stronger the antioxidant

Secondary metabolic level

In accordance with the findings of the secondary metabolism test, the rhizome of the bangle plant contained phenolic, flavonoid, and tannin-containing active substances, and also steroids, alkaloids, and terpenoids qualitatively. Different levels of the compounds involved in this secondary metabolism are evident in each organic fertilizer application. Different concentrations were produced by the concentration of active substances in the bangle rhizome. The data mentioned above demonstrated that, despite using the same amount of fertilizer, the active compound content of the bangle rhizome was highest when the rhizome was dry (low moisture content) as opposed to when the rhizome under fresh and dry conditions, correspondingly around 178.56 mg/L and 202.79 mg/L, was 60 t/ha. A dose of 60 t/ha of chicken manure also yielded higher levels of active flavonoids and tannins than other doses. When compared to the fertilizer treatment, the control had the lowest active compound content. When treated with cow manure, yields were lower than when treated with chicken manure at the same dose.

Antioxidant

Results of antioxidant analysis of bangle rhizomes using several samples based on manure dose and fresh and dry rhizome condition are shown Table 6. IC_{50} value obtained described how well the sample captured free radicals. The dose of 60 t chicken manure s/ha was found to have the lowest IC_{50} value of 9.52 ppm in the fresh sample, , while the control had the highest IC_{50} value of 53.58 ppm in fresh rhizome conditions. The same quality was obtained when dry rhizome conditions were used for the analysis; specifically, the dose of 60 t chicken manure /ha chicken manure produced the lowest IC_{50} value and the largest was in the control. The results of an analysis of variance (ANOVA) at a 5% level showed that the treatments of giving organic fertilizers in the form of chicken and cow manure gave significant differences in plant height, number of tillers, number of leaves, root length, fresh weight of rhizomes, and dry weight of rhizomes. Only root length that was not affected significantly by the treatments.

Discussion

Effect of manure addition on soil chemical properties

The changes of several soil chemical parameters during the incubation of three types of animal manures are presented in Table 2 until Table 6. According to the analysis of variance, almost all of the observed soil chemical characteristics were strongly affected by the differences in incubation time and manure rate. There were significant differences between the incubation time on pH H₂O, pH KCl, total N, exchangeable acid and base cations, CEC, BS (P<0.001), and organic C (P<0.01). Some parameters (e.g., pH H₂O, pH KCl, organic C, exchangeable bases, and base saturation) showed statistically high values and concentrations at the first two weeks, which decreased at the next four and six weeks. The increment in incubation time seemingly exhibited an inconsistent effect on the soil. Adekya et al. 2020 were reported that utilization of organic manure to meet crop nutrient requirement will be an unavoidable practice to enhance sustainable agriculture, this is because, the physical, chemical and biological properties of soil is generally improved by the addition of organic manures which in turn enhances crop productivity and maintains the quality of crop produce. Poultry litter treatments were positively correlated with greater soil fertility levels, as well as higher crop yield and soil biodiversity. These results underscore linkages between manure additions and cropping sequences, within the nutrient cycling, soil health, and crop production continuum (Asworth et al. 2018)

Plant Height

According to the Table 8, the average increase in plant height starting at 6,9,12,15, and 18 WAP tended to fluctuate. At the age of 6 weeks, the treatment without fertilizer (control) continued to grow until week 12 when it reached its peak with an average height increase of about 24.68 cm, before the delining height at the following weeks. In order for a plant to grow, nutrients must be obtained from the soil by the roots through their root hairs (Wang et al, 2021). Organic matter affects plant growth by influencing the physical, chemical, and biological properties of the soil (Delgado and Gomez, 2017). The more organic matter is provided, the faster the plant will grow. Compared to chicken manure, cow manure typically produces better plant growth. The application of chicken manure at all levels significantly increased plant height at 9 weeks after planting, but at 12 weeks, the plant height slightly decreased. In the 20 t/ha chichen manure treatment, the plant height was in average of 30.16 cm at 12 weeks after planting and decreased in the following weeks. High nitrogen elements are found in chicken manure (0.38%). Although the amount of nitrogen required by plants is always higher than other nutrients, a deficiency or excess of nitrogen can hinder and disrupt plant growth (Jiang et al 2021). After planting, the growth rate for height starts to slow down (Rademacher, 2015).

Applying chicken manure always results in the best plant response in the first growing season. This is because chicken manure decomposes relatively quickly and has enough nutrients compared to other manures of the same weight. Table 1 shows that the application of chicken manure tended to increase plant height rapidly at 6, 9, and 12 weeks of age, then declined as plant age increased. Large-scale application of chicken manure is thought to be less effective because the nutrients will exhaust quickly. The same result was also shown by the application of chicken manure at a dose of 40 t/ha which decreased the plant height, the maximum height increase at this dose was at 15 weeks with an average height increase of 37.61 cm. When compared to the other two doses of chicken manure, the plant height for the 60 t/ha chicken manure was different. The plant height increase over 18 weeks demonstrates this, but the increase in plant height was typically not too different from the previous weeks. Even though the application of chicken manure at a dose of 40 t/ha, at the end of the observation at 18 weeks the for the application of chicken manure at a dose of 40 t/ha, at the end of the observation at 18 weeks the for the with a week and the application of the dot to the the three of 40 t/ha, at the end of the chicken manure at a dose of 40 t/ha, which caused a decrease in plant height.

The addition of cow manure improves soil permeability, total pore space, aggregate stability, bulk density, texture, color, and temperature (Singh, 2021). A dose of 60 t/ha of chicken and cow manure had the tendency to produce steady, dependable results. The application of cow manure at a dose of 60 t/ha tended to yield less than chicken manure at doses of 40 and 60 t/ha from the start of planting until the plant was 9 weeks old, but the yields increased in the following weeks. The plant's need for nutrients grows as it ages. If the nutrient requirements are not met and the nutrients are not readily available, plants may got nutrient deficiency at specific times (Bindraban et al, 2015). Bangle plants absorb N (0.06 - 3.07 g), P (0.01 - 0.53 g), and K (0.10 to 2.25 g) at 2 to 10 months after planting in the canopy. N is the nutrient that is most required in the plant canopy itself. The primary nutrient for plants, nitrogen, is typically essential for the development and expansion of vegetative parts of plants, such as leaves, stems, and roots (Tegeder and Masclaux-Daubresse. 2017). A sufficient supply of plant N is indicated by high photosynthetic activity, good vegetative growth, and dark green plant colors (Wei et al, 2015).

Due to the individual characteristics of each animal, which are influenced by the type of feed and the animal's age, each manure contains a different mix of nutrients (Asworth et al., 2020). Because each treatment dose of fertilizer has a different nutrient content, they all produce different yields and have different recommended doses. Due to their movement with crop yields, surface runoff, erosion, or evaporation, nutrients in the soil will gradually decrease over time (Liao et al., 2021).

Number of Tillers

The table of the total number of tillers from each level reveals results that increase with plant aging and are influenced by the quantity of fertilizer applied, as shown in Table 9. Plants withot fertilizer developed more tillers every week, but the growth was typically modest. This slight increase resulted from the fact that during the initial stages of planting, the products of photosynthesis were utilized for the vegetative development of plants. In comparison to manure application, treatment without fertilizer produced the lowest yield. Data presented in Table 9 show that there was a noticeable increase in the number of tillers at 18 WAP of age. A plant needs nutrients for its physiological processes during growth and development. Plant growth and production will be subpar due to a lack of nutrients (Reich et al., 2014). Functions of organic matter as a biological buffer so that the soil can supply plants with a balanced amount of nutrients (Nair, 2019). Loosening the topsoil, increasing water absorption and storage, and boosting soil fertility are all important functions of manure (Murphy, 2015). A sudden rise in the number of tillers of tillers can result from the ease with which new shoots can emerge from loose, moist soil.

Commented [15]: Data presented in this Figure (graph) seem similar to that shown in Table 1; please choose one presentation only, Table or Figure (graph), not both At the start of planting, there were typically fewer and nearly identical numbers of tillers in each treatment. The nutrients in this fertilizer are not readily available to plants, which is the cause of the slow plant growth at the start of the planting period. The extent of these materials' mineralization or decomposition has a significant impact on the nutrients' availability. Manure's low nutrient availability is partially caused by the presence of N, P, and other elements in complex compounds that are challenging to decompose (Cui et al., 2021). At 6 weeks after planting, all treatments tended to be similar and the differences between the tillers in each treatment tended to be minimal. Although cow manure at a dose of 60 t/ha was the best dose with an average number of tillers of 14.45 tillers, chicken manure typically produced better results than cow manure at the same dose. In comparison to other manure doses, chicken manure 40 t/ha at 12 weeks after planting produced the best results with 6.65 tillers.

Number of Leaves

An increasing number of leaves are produced each week as a result of the weekly application of cow and chicken manure. Table. 10 show that at about 12 weeks of age, the number of leaves increased significantly. Every week, the increase varied depending on the treatment. The number of leaves significantly increased with a dose of 60 t/ha of cow manure, averaging 15–37 leaves every three weeks. Similarly, the number of leaves tended to increase when manure was applied in the same amount. Both cow and chicken manure at a dose of 20 t/ha and 40 t/ha produced a nearly identical number of leaves during plant growth. In addition to the nutrients that plant's needs, manure also contains humic, fulvic acids, growth hormones, and other substances that promote plant growth and increase nutrient uptake by plants (Canellas et al., 2015). The amount of photosynthesis is influenced by the number of leaves added is also affected by the number of shoots and plant height. The number of leaves will increase as the plant agrows taller, produces more leaves on a single stem, and produces more tillers. The nutrients required for plant growth are present in sufficient amounts in manure. The related observation variables will be impacted by the food's growth quality and planting age.

In relation to the addition of the number of leaves, the most influential element is N. In comparison to other nutrients, nitrogen is required in sufficient amounts for plant growth. N makes up 40–50% of the dry weight of protoplasm, the living component of plants (Kathpalia & Bhatla. 2018). Since protein is the source of all plant enzymes, nitrogen participates in all enzymatic processes in plants. Additionally, nitrogen is one of the constituent elements of chlorophyll, the primary component of chlorophasts, and it contributes to improving the quality and quantity of the dry matter produced (Wen et al., 2020). Fertilizer use and the amount of nutrients in a minimum state (Purba et al., 2021). In terms of the addition of leaves, the treatment of plants without fertilizer significantly enough for each observation. In comparison to other treatments, plants without fertilizer produce the lowest yield.

Root Length

The lowest root length was observed for the cow manure dose of 20 t/ha treatment with an average root length of about 24.36 cm which was lower than the control. With an average root length of 41.03 cm, the application of chicken manure yielded the longest roots. When plants respond to water shortages by reducing the rate of transpiration to conserve water, the roots play a crucial role (Sourour et al., 2017). Plant roots have a significant impact on overall plant growth and development. The failure of the root function will result in a complete change in the plant for the top. Manure can bind water in the soil. Because the soil around the roots in the deeper layers is still moist, the roots will continue to grow. Maximizing exposure to groundwater will encourage the growth of root. Plant roots directly respond to the physical characteristics of the soil (Jiang et al, 2017).

Data presented in Table 11 show that the application of chicken manure yielded better root length than cow manure. The use of organic fertilizers can loosen the soil, increase aeration, and increase the soil's capacity to hold water, all of which can improve the physical properties of the soil (Shaji et al., 2021). Additionally, organic matter has the ability to control soil temperature, slow down phosphorus fixation, increase soil cation exchange capacity, and lessen the leaching of nutrients like potassium, calcium, and magnesium (Baghbani-Arani et al., 2021). Another environmental factor that has been shown to affect the nitrate absorption process is the temperature around the roots (Le Deunff, 2019). The initial analysis of the soil revealed that the pH ranged from 3.86 to 4.86. Al is common excessively in acidic soil, and it can poison plants and bind phosphorus (P). Low pH soil can hinder plant growth by preventing the roots from properly absorbing nutrients. Giving chicken manure, as demonstrated by Mažeika et al. (2021), can maintain stable nutrient content in soil and minimize mineral fertilizer influx into the environment. could raise the pH of soil. By raising pH, Al in the exchangeable form will be reduced, and nutrients will become more available to plants.

According to Rosita et al. (2005), nutrient uptake on the roots of bangle plants at 2-10 months after planting was as follows: N (0.01 - 0.52 g), P (0.002 - 0.15 g), and K (0.02 to 0.82 g). It was discovered that the roots of the bangle plant had more K buildup than N and P. K is primarily used to aid in the synthesis of proteins and carbohydrates. In the face of drought, illness, and pests, potassium gives plants strength (Hasanuzzaman et al.,

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2018). Organic fertilizers can help the soil's physical and chemical composition, which will facilitate root development. Up until the soil reaches its critical water potential, plant roots expand into moist soil and draw water (Sisouvanh et al., 2021). The looseness of the soil can promote root development. Strong roots will make it simpler for plants to absorb nutrients and water

Rhizome fresh Weight

Plant biomass is a common parameter used to study plant growth. When plant nutrient requirements are met, yields will be optimal (Timsina, 2018). The rhizome of the bangle plant is the part that is most advantageous for cultivation. One could also argue that this rhizome's fresh weight is a crucial factor in determining how well bangle plant cultivation is going. The cultivation method is better and more productive the more weight of the wet rhizome can be obtained. According to the results of the application of the organic fertilizers at the age of 18 weeks, cow manure at a dose of 60 t/ha produced the highest fresh weight of rhizomes, averaging 822 g/plant, and chicken manure at a dose of 20 t/ha produced the lowest fresh weight of rhizomes, averaging 393.25 g/plant. Manure increases crop yield and quality while also enhancing the chemistry, physical characteristics, and biological properties of the soil (Ma et al., 2021). Data presented in Table 11 demonstrate that the yield of fresh weight of rhizomes increased with increasing manure dosage. The physical condition of the soil must support plant growth in addition to a supply of adequate and balanced nutrients (El-Ramady et al., 2015). These soil aggregates will keep the soil in a loose condition (Murphy, 2015). Cow manure will enhance the physical characteristics of the soil. Improved soil physical characteristics include things like increased permeability, total pore space, aggregate stability, bulk density, texture, color, and temperature (Agbede, 2021).

Intensive tillage affects the physical properties of the soil. Low organic matter soils will have more severe damage to the soil's structure (Murphy, 2015). When the soil does not receive enough water and becomes dense and hard, soil damage is evident. Plant rhizomes will not be able to grow or spread out in compacted or hard soil. The ability to maintain loose soil conditions that are difficult to harden or compact increases with the amount of organic matter added. Additionally, manure helps to improve soil structure, cation exchange capacity, and water resistance. Giving manure has the indirect effect of making it simpler to keep water in the soil (Zhang et al., 2016). Since water availability plays a significant role in plant growth, water frequently restricts the growth and development of cultivated plants. The plants will experience drought conditions if there is not enough water in the soil. Due to decreased primary metabolism, reduced leaf area, and decreased photosynthetic activity, drought stress can lower plant productivity (biomass). Smaller leaves grow as a result of a lack of water during the vegetative stage, which can reduce light absorption. Lack of water also inhibits the synthesis of chlorophyll and some enzymes, such as nitate reductase, from working (Altuntas et al., 2020).

Organic substances in the soil may have physiological effects on plant growth that are direct or indirect (Basilio et al, 2013). Compared to other types of manure, chicken manure contains a fair amount of P. This is due to the fact that chicken manure contains feed (Agbede, 2021). Phosphorus aids in the growth of plant roots, photosynthesis, transfer respiration, cell division, and growth (Malhotra et al, 2018). The number of cells increases more quickly when they divide quickly, which causes the rhizome to grow larger.

Rhizome Dry Weight

Dry weight reflects a plant nutritional status because it is affected by the rate of photosynthesis and respiration in each treatment. Based on the collected data, it was determined that applying chicken and cow manure at a dose of 20 t/ha resulted in lower dry weight yields than the control. Additionally, the results from the application of 40 t/ha manure dose were not significantly different from the control. This is the active vegetative formation stage. The application of cow manure at a dose of 60 t/ha demonstrated different results and produced significantly better outcomes than other doses of chicken manure. The amount and timing of fertilizer applied can impact crop yields, among other things. Organic matter plays a crucial role in soil health because it can create stable soil aggregates, increase soil fertility, and serve as a source of energy for organisms (Magdoff. 2018).

The application of manure enhances the chemical, physical, and biological properties of the soil, increase crop yield, and improves crop quality (Du et al., 2020). High organic matter soils have beneficial microorganisms that encourage the breakdown of organic matter and release inorganic nutrients that are then available for plant uptake. Organic fertilizers can help to create ideal conditions in the soil for microorganisms that are beneficial to plants (Du et al 2022). Chicken manure is an organic fertilizer with high nitrogen content, despite not being the best dose for bangle rhizome weight yield. As they ensure the best nutrient management for plants, such fertilizers should be used promptly to partially replace chemical fertilizers (Guimarães et al., 2019).

Secondary metabolic levels (phenolic compounds, flavonoids and tannins)

The results of laboratory analysis found that the positive bangle rhizome contains compounds in the form of phenolics, tannins and flavonoids. These compounds respond differently to the concentration of organic fertilizer applied in the form of cow and chicken manures. According to Table 12, the amount of tannin compounds

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increased as manure dosage rose. The application of chicken manure or cow manure with three doses of 20, 40, and 60 t always increased the tannin concentration in the rhizome as the dose increased. When compared to cow manure, applying chicken manure produced significantly better results. It is evident that using 20 t/ha of chicken manure instead of 60 t/ha of cow manure resulted in a higher tannin concentration.

Dry rhizomes produced a higher concentration of tannins than fresh rhizomes, which produced different results regarding tannin concentration. The concentration of tannins in fresh rhizomes increased non-significantly with the addition of cow manure, whereas the concentration of tannin compounds in fresh rhizomes decreased with the increase in the dose of cow manure. In comparison to the use of manure that increased fresh and dry rhizomes, the control provided the lowest tannin concentration.

Tannins are chemical substances that have an astringent and bitter flavor. These substances act as controlling substances in plant metabolism as well as important defenses against herbivores and pests that prey on plants (Tiku, 2018). Tannins are metabolically active substances with multiple uses, including as astringents, antibacterial agents for treating diarrhea, and antioxidants. Leather tanning is another industrial application for tannins. Tanad acid is the type of tannin substance present in bangle plants. Diarrhea can be effectively treated with tannic acid. Additionally, tannic acid exhibits antimicrobial, antienzymatic, antioxidant, and antimutagenic properties (Dabbaghi et al., 2019).

In addition to increasing the fertilizer dose, applying organic fertilizer in the form of cow and chicken manure resulted in an increase in phenolic compounds and flavonoids. When compared to when the rhizome was fresh, the dry rhizome had a higher concentration of phenolic and flavonoid compounds. The content of active compounds in the simplicia is impacted by the drying process. Antioxidant activity is influenced by the total phenolic and flavonoid content (Rajkumari & Sanatombi, 2020).

The highest phenolic and flavonoid concentrations were found in both fresh and dry rhizomes when chicken manure was applied at a dose of 60 t/ha. The application of the highest dose of cow manure of 60 t/ha, resulted in phenolic compound concentrations of 86.90 mg/L in the fresh rhizome and 181.38 mg/L in the dry rhizome, while flavonoids were 71.14 mg/L in fresh rhizome and 99.43 mg/L in dry rhizome. Compared to chicken manure at the same dose, this result is smaller. A dose of 60 t/ha of chicken manure resulted in phenolic compound concentrations in the fresh rhizome of 178.56 mg/L and dry rhizome of 202.79 mg/L, while fresh rhizome flavonoids were 104.39 mg/L and dry rhizome flavonoids were 181.91 mg/L. In comparison to treatments without fertilizer produced lower phenolic and flavonoid concentrations.

In plants, flavonoids serve as pigments for the flowers, fruits, and roots, as well as occasionally as growth regulators and disease resistance (Kumar et al, 2018). Catechins are one class of flavonoid compounds present in bangle rhizomes (*catechins*). Catechins have antioxidant properties, and because they can stop the growth of viruses, bacteria, tumors, and fungi, they can also get rid of rotten and rancid odors (Isemura. 2019). Phenolic compounds are compounds that plants make in response to environmental stress. Phenolic compounds protect DNA from dimerization and damage by blocking UV-B rays and cell death (Takshak and Agrawa, 2019). Gallic acid is the type of phenolic compound found in bangle rhizome. Gallic acid serves as an antibacterial, antiviral, analgesic, and antioxidant in medicine (Shrinet et al, 2021).

The application of chicken manure resulted in a higher concentration of secondary metabolism because it had a relatively higher P nutrient content than other manures (Alinejad et al, 2020). Phosphorus can be found in DNA, RNA, and the parts of nucleotides that provide metabolic energy (like ATP). The process of photosynthesis depends heavily on phosphorus. Stunted growth is one of phosphorus deficiency's signs (De Bang, 2020). The concentration of secondary metabolism in the form of tannins, phenolic compounds, and flavonoids is influenced by the difference in the P nutrient content between these two types of manures. Environmental factors affect the levels of flavonoids and other phenolic compounds in plants, which vary among parts, tissues, and ages of plants. These include air temperature, nutrient availability, water availability, and atmospheric CO_2 concentrations (Ashraf et al, 2018.).

Antioxidants

The antioxidant activity analysis produced different IC_{50} values depending on the type of organic fertilizer used (Table 13). The IC_{50} decreased as the fertilizer dose increased. A concentration known as IC_{50} is capable of reducing 50% of DPPH free radicals. The greater the antioxidant activity, the lower the IC_{50} value (Ali et al., 2018). Antioxidants are compounds that can absorb or neutralize free radicals, thereby preventing certain diseases caused by free radicals (Poprac et al 2017). The treatments of cow manure, as shown in Table 13 resulted in lower yields than chicken manure. The antioxidant activity of the dried rhizome samples was higher than that of the fresh rhizomes. The highest antioxidant activity was produced by cow manure at a dose of 60 t/ha, with an IC_{50} value of 9.52 ppm for fresh rhizome and 8.6 ppm for dry rhizome. At a dose of 20 t/ha in both fresh and dry rhizome conditions, cow manure had a lower IC_{50} value than chicken manure. For fresh rhizomes, the treatment without fertilizer produced an IC_{50} value of around 53.58 ppm, and for dry rhizomes, it was around 40.91 ppm.

Ali et al. (2018) claimed that the antioxidant activity in bangle rhizomes is incredibly powerful. Except for the treatment without fertilizer in fresh rhizome conditions, the IC₅₀ value in bangle rhizome in all treatments gave

a value of 50 and included a very potent antioxidant. The high secondary metabolic compounds found in the bangle rhizome are inextricably linked to the high antioxidant activity. Secondary plant metabolites like flavonoids and phenolics play a part in antioxidant activity. More phenolic compounds will have a higher level of antioxidant activity (Tohma et al, 2017).

Conclusion

A cow manure dose of 60 t/ha is the best dose for plant grwth, with an average height increase of 42.78 cm, an increase in the number of leaves of 116.65 pieces, and an increase in the number of tillers of 14.45. A dose of 60 t/ha of chicken manure produced the best root length of 41.03 cm. The weight of the rhizomes revealed that the application of cow manure at a dose of 60 t/ha resulted in the highest yields of dry weight and wet weight, which were about 179.75 g and 822 g, respectively. A chicken manure dose of 60 t/ha results in the highest secondary metabolic rate in each parameter, including dry rhizome (phenolic 202.79mg/L, flavonoid 181.91mg/L, and tannin 5406.33mg/L) and wet rhizome (phenolic 178.56mg/L, flavonoid 104.39mg/L), while a chicken manure dose of 40 t/ha results in the highest tannin Giving chicken manure at a dose of 60 tha produced very strong antioxidant results a 9.52 ppm wet rhizome and 8.06 ppm dry rhizome, according to the antioxidant results.

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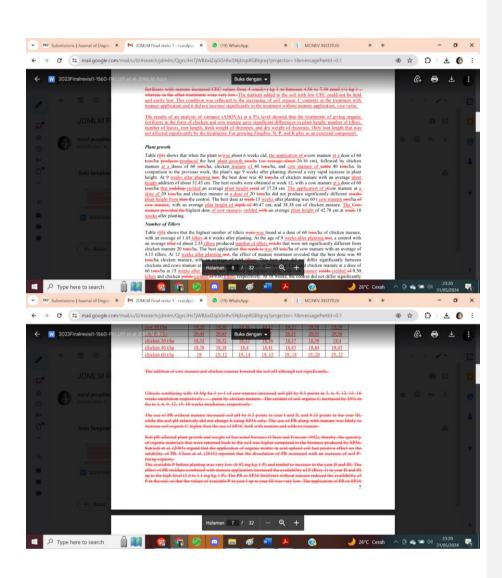
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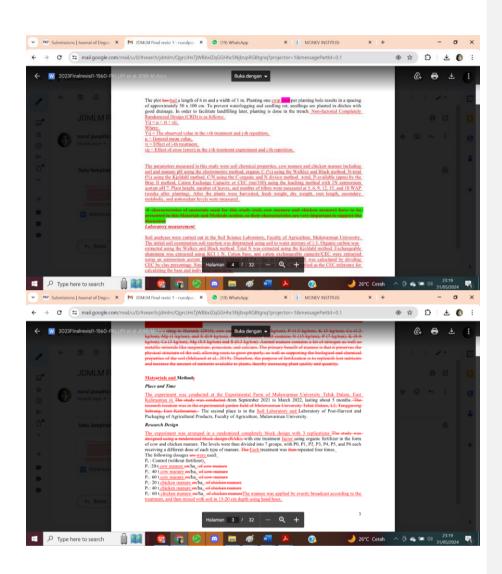


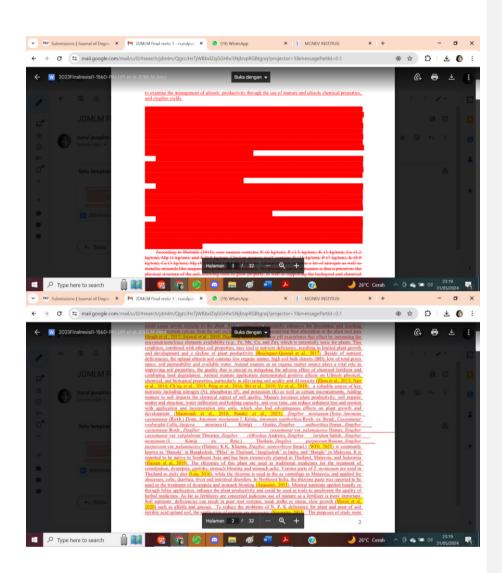


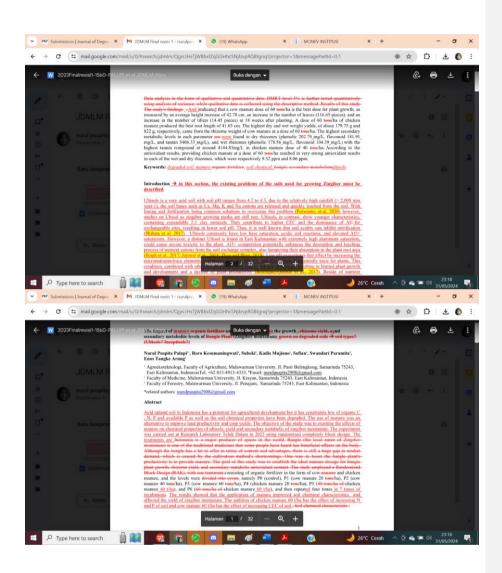
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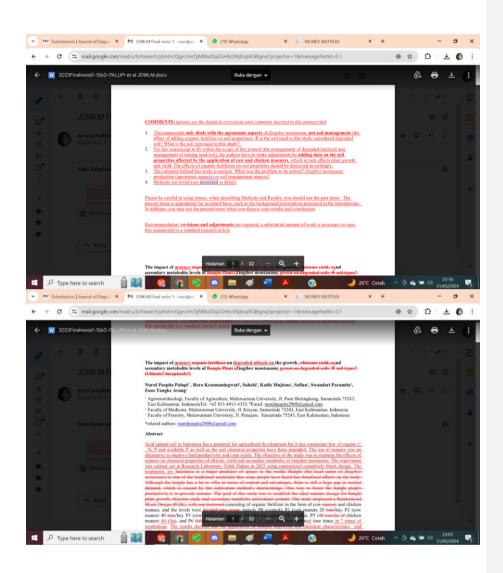
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0	🕅 kepada saya 👻	decrease in organic C ecosystems, C-organic as a source of energy f	occurred is an impo	with the add rtant compon	lition of chicken ent that influence	manure 20 t/ha s soil properties	as shown to support pl	in Table 3. 1 ant growth, n	n soil				
р•		Table 3. Soil Chemical											
	Satu lampirar	Manure Treatments			chemical Organi								
		week incubation	0	3		12	15	18					
	Contraction of the local	control	0,18	0,18	0,18 0,		0,18	0,17					
	· Constanting of the second	cow 20 t/ha	0.83	0,8	<u>0,78</u> <u>0</u> ,		0,46	0,4					
•	2023Finale	cow 40 t/ha cow 60 t/ha	<u>1.31</u> <u>1.4</u>	<u>1,27</u> 1,37		<u>19 1,08</u> 32 <u>1,31</u>	<u>1.07</u> <u>1.31</u>	<u>1,01</u> <u>1,3</u>					
		chicken 20 t/ha	0,36	0,33	0.32 0		0,21	0,18					
		chicken 40 t/ha	0,42	0,42	<u>0,41</u> <u>0</u> ,		0,31	0,26					
	- Balas	chicken 60 t/ha Application of all leve	<u>0,98</u>	0,98	<u>0,95 0</u> ,		<u>0,8</u>	0,78					
		The best increase in N Table 4. Soil Chemical Manure Treatments		alaman ^{ie N} 6		atme Q +							
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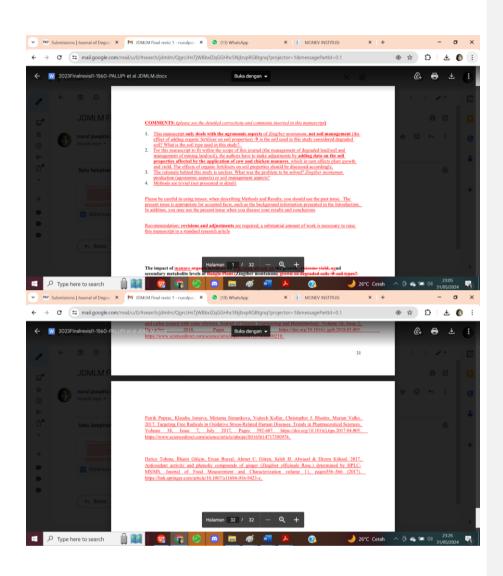
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	JDMLM F	2,08% for cow manure an										
* 0	epada saya +	the The manure containe study was high. Manure was affected by the matu metallic minerals like ma	could imp rity of m gnesium,	prove soil chemical a anure (Cai et al, 201) potassium, and calciu	nd physical prop). Animal man m. The primary	erties effectively re contains a lot benefit of manur-	y, and the plant growth t of nitrogen as well as e is that it preserves the		☆ ☺			
⊳ D [●]	Satu lampirar	physical structure of the s properties of the soil (Me and increase the amount gradually release nutrient	Isasail et t of nutri s into the	al., 2019). Therefore ients available to pla soil solution and mai	the purpose of nts, thereby in ntain nutrient ba	fertilization is to reasing plant quance for healthy	replenish lost nutrients uality and quantity by growth of crop plants.					-
~		They also act as an effecti (Shaji et al. 2020). Tabal I. Chemical Chemi			bes which in tur	i improve soil str	ucture and crop growth					
+		Tabel 1. Chemical Charac	teristic o		l properties		1					
	2023Finalr		<u>pH</u>	<u>C (%)</u> <u>N (?</u>		P (ppm)	water content (%)					
		Cow	<u>6.5</u>	<u>29,55</u> <u>2,0</u>		0,17	72,9					
	🗧 🕁 Balas	Chicken	<u>6,4</u>	<u>40,51</u> <u>1,3</u>	29,57	<u>0,67</u>	60,63					
		As a function of soil che		rgank manure could	to that the crQ		vas important to hold a					
		given inorganic fertilizer acidity (Shi et al, 2019). the efficiency of P absor		laman 10 5 ep/2032 Corporte materials of rops because in the p	creased the avail	lability of some	om the pressure of soil nutrients and improved position humic acid and					
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← №	2023Finalrevisi1-1560-PALUPI o	CEC by clay percentage calculating the base and in	ate (NII) Since the sdividual	observed saturation Buka der	gan 👻 be ECI	C was applied as	esteutated by dividing s the CEC reference for		¢	÷	Ŧ	0
1	e 🗉 O I	Data Analysis							$- \delta = 0$	1		E
1	JDMLM F	Soil data's were analyzed Models, v.6.12 for windo Duncan Multiple Range	ws (Ram Test (DN	on et al. 1992). Data IRT) at 5% significa-	were analyzed l toe level. The fi	ry analysis of va nancial effective	riance and followed by mess of each treatment					
*		was calculated by input- increase in the number of the wet and dry weights o collected every three wee	Fleaves; (Frhizoms	an increase in the nur es; and an increase in	sher of tillers; a secondary metal	n increase in roo olic and antioxid	t length; an increase in- lant levels. Data will be		÷ ©			
© ≽		15, and 18 WAP (weeks in the plants were harvested	flor plan	ting)MST for height, h weight, dev weight,	ndditional numb	er of leaves, and indervimetabolic	number of tillers. After					
0*	Satu lampirar	among treatments If the	d by a 5% re varian	6 level DMRT (Dune ee is obtained and t	in Multiple Ran	e Test) to detect that each treats	t significant differences ment in each group is-					
		significantly different fro metabolic level identifica methods. Comparing phy	ition and	antioxidant activity	tests were analy	zed qualitatively	y using the descriptive					
-		levels. Antioxidant activ spectrophotometry metho	ity is-wa	s assessed by comp	aring the IC50	values in each	treatment. We used A					+
		Results and Discussion			Landardonada							
	CO SOSTAHAN	Results										
		Manure Quality The results of manure and organic C content was rel	alysis (Ta latively h	ble 1) showed that the igh (29.559.50%) for	e nutrients conte cow manure an	nt in the manure 1 40.51% for chi	were very low but the					
	(+1 matin	water contents was chara	cterized a	it moderate level (72	9% and 60.63%	34.30% respecti	fely). N total are about 4					
			На	laman 4 / 3.	_ Q	+						
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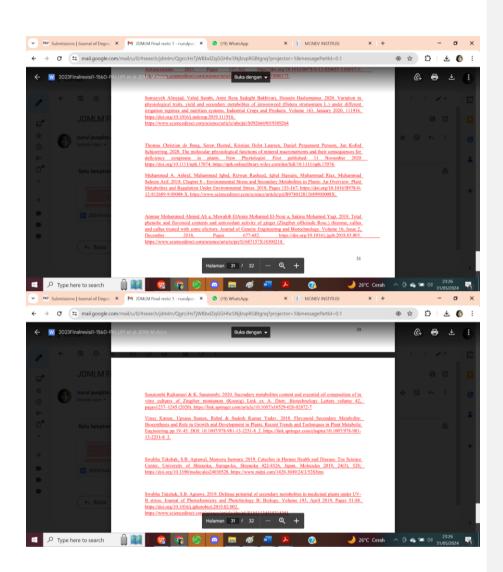


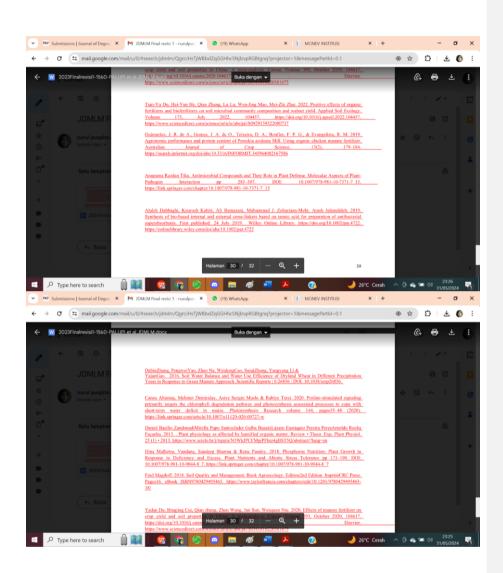


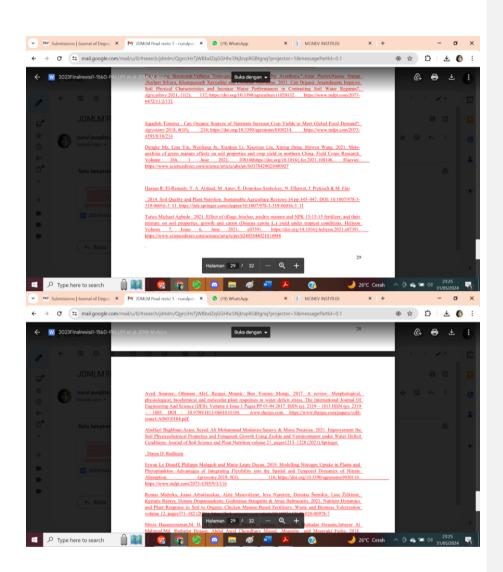


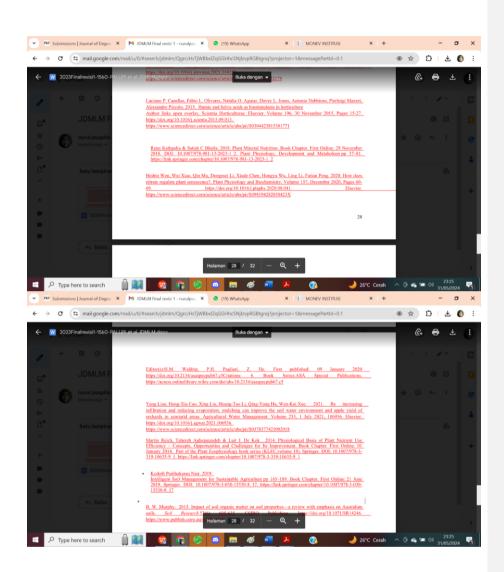


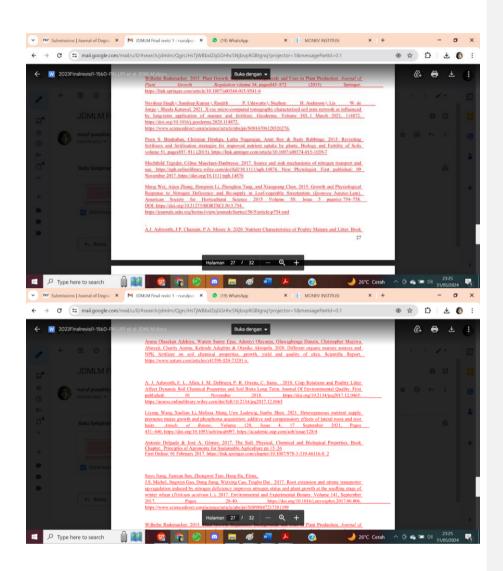


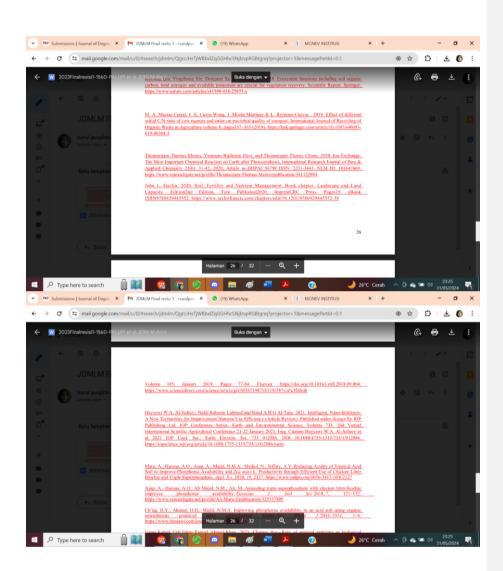


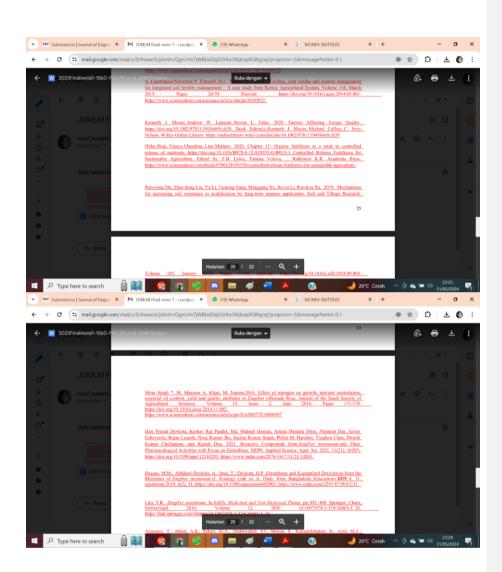


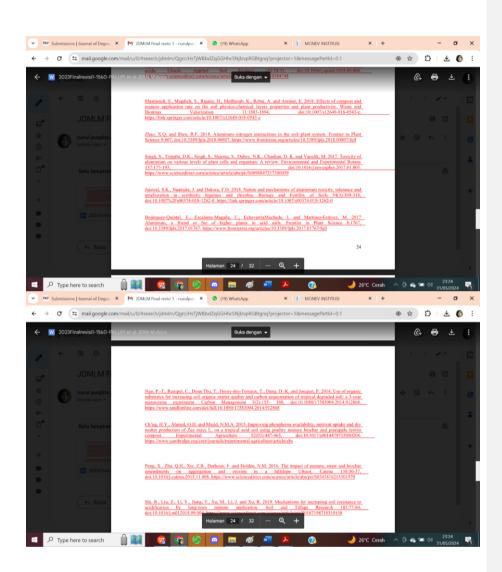


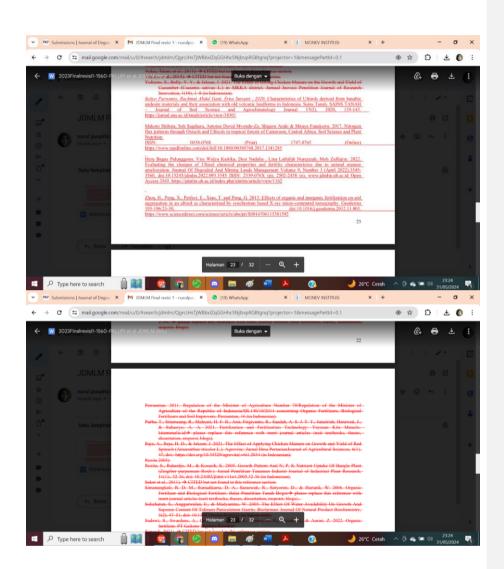


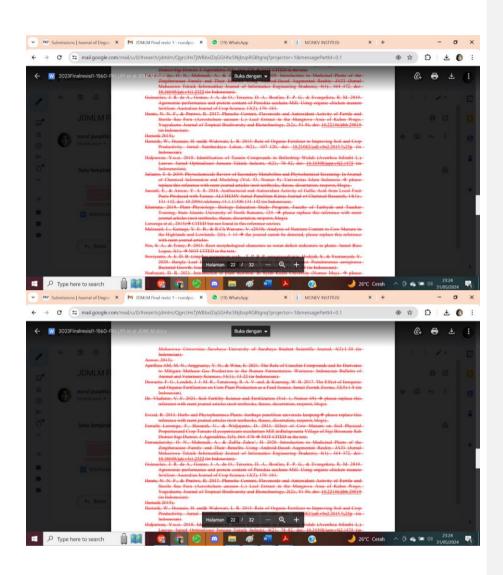


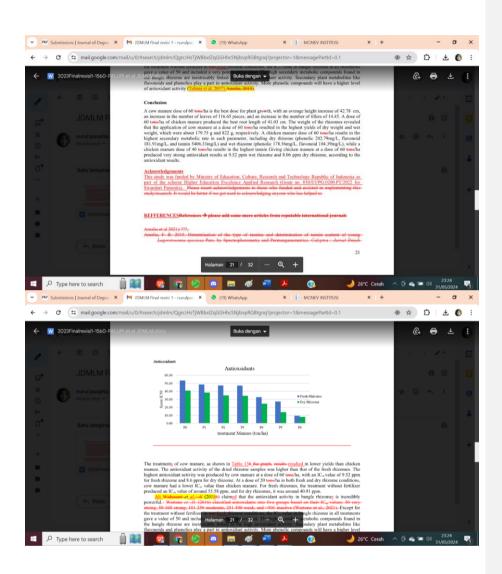


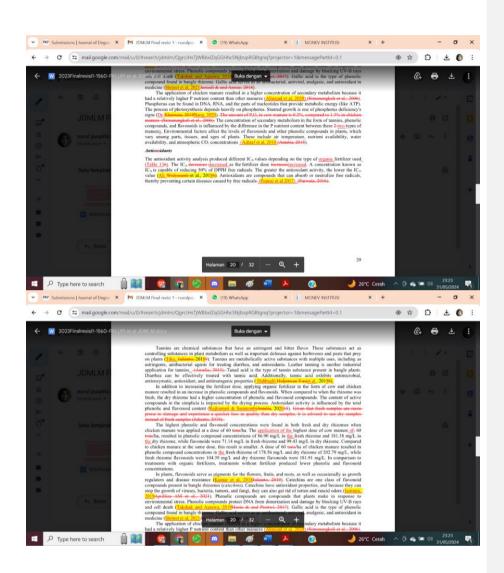


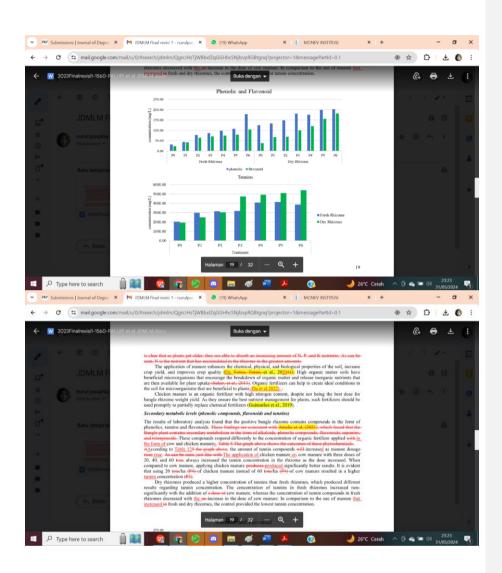




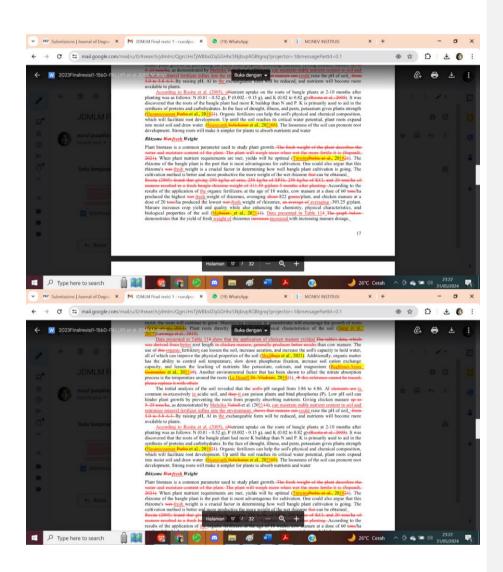


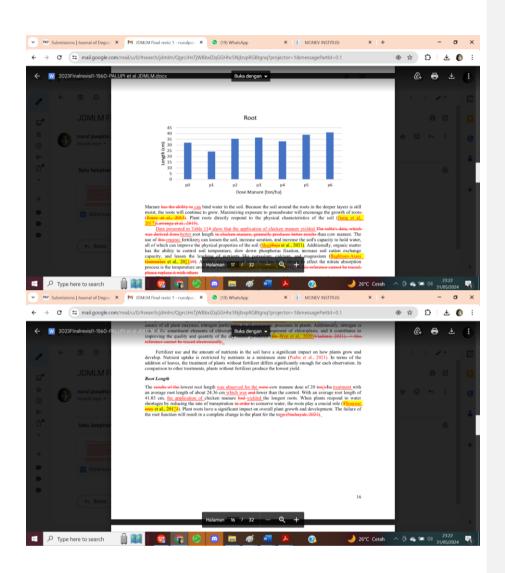


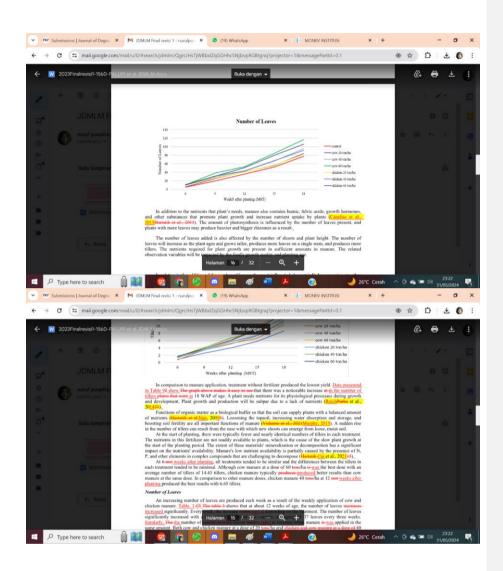


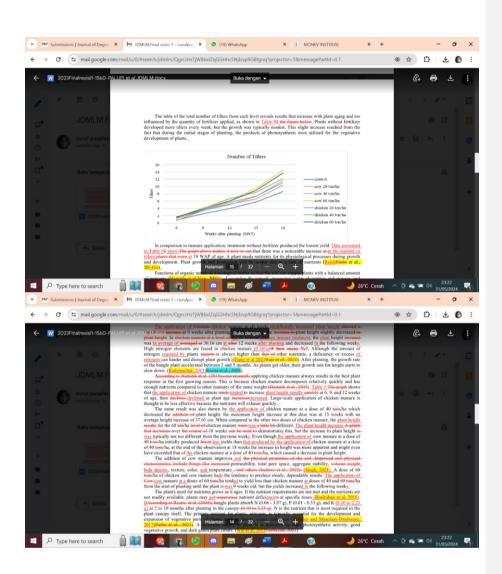


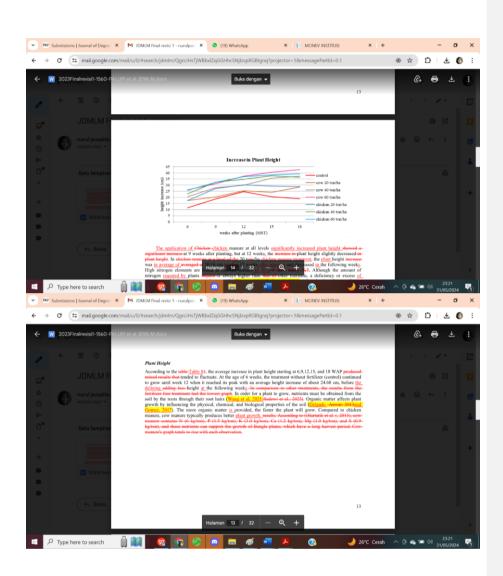














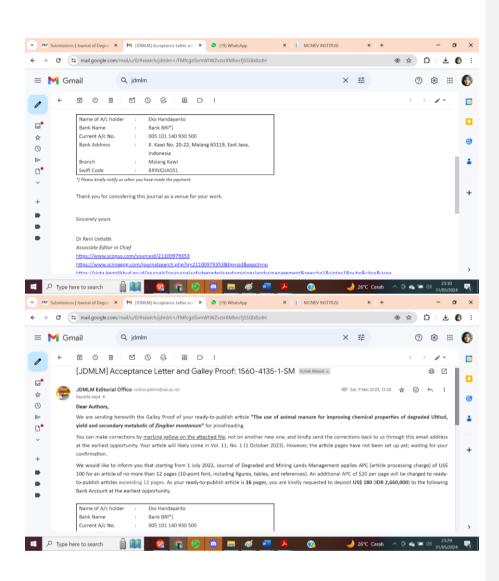
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	JDMLM F	Condition	Treatment	Phenolic	Level (mg/L) Flavonoid	Tanin				
3*	JUNILIVI FI		Control Cow 20 ton/ha	31,64 43,18	23,08 41,55	2034,83 2991,50				
	nurul puspita	Fresh	Cow 40 ton/ha	77,03	64,30	3151,50		☆ ☺		
, U	kepada saya 👻	Fresh	Cow 60 ton/ha Chicken 20 ton/ha	86,90 97,67	71,14 74,79	3198,17 4086,50				
			Chicken 40 ton/ha	107,54	78,71	4144,83				
•	Satu lampirar		Chicken 60 ton/ha Control	178,56	104,39 38.44	3861,33				
	Satu lampirar		Cow 20 ton/ha	133,56	67,23	2504,00				
	and the state of the	Dry	Cow 40 ton/ha Cow 60 ton/ha	148,44 181,38	68,76 99,43	3034,83 4734,67				
		519	Chicken 20 ton/ha	175,23	120,06	4903.00				
			Chicken 40 ton/ha	198,69	156,10	5088,00				
•	2023Finaln	Note: The n	Chicken 60 ton/ha umber followed by yellow est, and phenolic-test result	denotes the best outcome <u>s contents</u> .	181,91 in each observation v	5406,33 ariable for the flavon	ioid-			
		Tabel <u>13</u> 6 Excel forma	Antioxidant based on IC50 4), not in JPEG format, as J	value -> Tables have to b PEG format cannot be ed	e-presented-in-Word-I ited.	ormat (generated from	m-			
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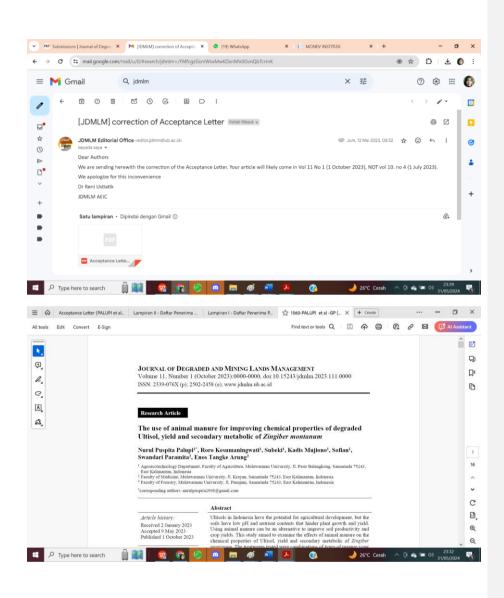
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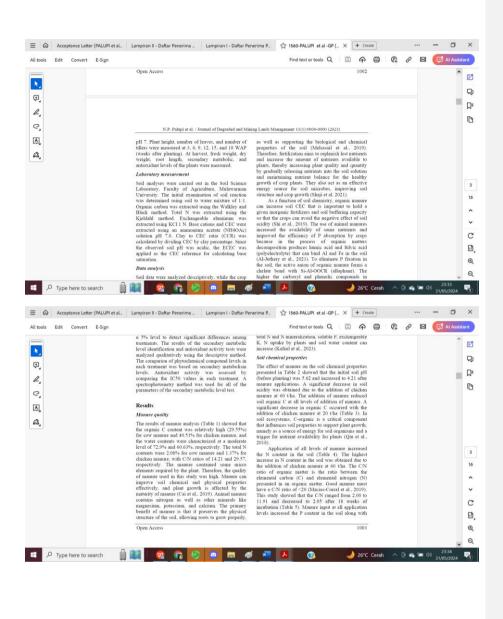
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	organic fertilizer secondary metabolism	(cow manure 20 t/ha (chicken manure 20), P2 (cow manur t/ha), P5 (chick	e 40 t/ha), P3 (cow ma en manure 40 t/ha),	nure 60 t/h and P6 (ch	a), P4 nicken						
	Ultisol Zingiber montanum	manure 60 t/ha). The	e results showed	that the application of of the soil, and the ap	chicken m	anure						
	angiotr monutan	manure of 60 t/ha in-	creased soil cation	exchange capacity. T est plant height, the m	he applicat	ion of						
		and the number of	at 18 weeks aff	er planting, while th ed the longest plant re	e applicati	on of						
•		fresh and dry rhizo	me weight was a	bserved for the 60 t	ha cow m	anure						
		found in dry rhizom	es (phenolic, flav	tabolic levels in each onoid, and tannin) an	I fresh rhiz	zomes						
		of 40 t chicken man	ure/ha. Applying	hest tannin compound chicken manure at a	dose of 6							
				eld in fresh and dry rh								
	To cite this article: Palupi, N.P., use of animal manure for improv	ing chemical properties of	degraded Ultisol.	rield and secondary met	abolic of Zi	neiber						
	montanum. Journal of Degraded ar	id Mining Lands Manageme	nt 11(1):0000-0000	, doi:10.15243/jdmlm.20	23.111.0000),						
	Introduction		of 7 montance	n are used in Thailan	l as a dail	u diat						
	Zingiber montanum Roxb. (WF	O. 2021) is commonly	(Lim, 2016),	while the rhizome	is used	as a						
	known as "Banada" in Ba Thailand, "Jangliadrak" in In	ngladesh, "Phlai" in	colic, diarrhea	Malaysia and applie , fever and intestin	al disorder	rs. In						
	Malaysia and Indonesia, is o Thailand, Malaysia, and Indo	extensively planted in	used to trea	a, rhizome paste was t dyspepsia and st	omach ble	oating						
	2019). This plant is common medicines to treat constitution	ily used in traditional	(Anasamy, 20) productivity of	3). In East Kalimanta this plant, commonly	n, Indonesi cultivated	in the						
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	Ultisol contains expandable 2:1 clay minerals that	September 2021 to March 2022. The second place	
3	contribute to high cation exchange capacity (CEC)	was in the Soil Laboratory and Laboratory of Post-	
	and the dominance of Al ³⁺ in exchangeable sites, resulting in low pH. It is well-known that soil acidity	Harvest and Packaging of Agricultural Products, Faculty of Agriculture, Mulawarman University, The	
	can inhibit nitrification (Shibata et al., 2017). A	chemical compositions of the soil, cow manure, and	
	distinct Ultisol is found in East Kalimantan with extremely high aluminum saturation, which can cause	chicken manure used in this study are presented in Table 1.	
	severe toxicity to the plant. Al ³⁷ enhances the	Research design	
•	desorption and leaching of nutrient cations from the		
L	soil exchange complex, hampering their absorption in the plant root area (Singh et al., 2017; Jaiswal et al.,	The dosages of manure applied were P0 (control; without fertilizer), P1 (cow manure 20 t/ha), P2 (cow	
	2018; Zhao and Shen, 2018). Low pH exacerbates	manure 40 t/ha), P3 (cow manure 60 t/ha), P4 (chicken	
	that effect by increasing the micronutrients/trace elements availability (e.g., Fe, Mn, Cu, and Zn).	manure 20 t/ha), P ₅ (chicken manure 40 t/ha), and P ₆ (chicken manure 60 t/ha). The seven treatments were	
	which is potentially toxic for plants. This condition	arranged in a completely randomized block design	
	and other soil properties may lead to nutrient deficiency, resulting in limited plant growth and	with three replications with one treatment factor using organic fertilizers (cow manure and chicken	
	development, including poor root systems, weak	manure).	
	stalks or stems, and declining plant productivity (Bojörquez-Quintal et al., 2017; Moore et al., 2020).	Table 1. Chemical composition of the soil, cow	
	Besides nutrient deficiencies, the upland Ultisols soil	manure, and chicken manure used in this	
	contains low organic matter, high soil bulk density, low total pores space, soil permeability and available	study.	
	water.	Chemical Soil Cow Chicken Properties Manure Manure	
	Liming and fertilization are the common solutions to this problem (Purpranto et al. 2020)	Properties Manure Manure pH 5.62 6.50 6.40	
	solutions to this problem (Purwanto et al., 2020). However, most farmers cannot afford to buy lime and	Organic C (%) 0.18 29.55 40.51	
	fertilizer to improve soil fertility to increase the productivity of the Z. montanum they cultivate.	N (%) 0.14 2.08 1.37 C/N 1.29 14.21 29.57	
	Alternatively, farmers use animal manure as a source	Available P (ppm) 10.52 0.17 0.67	
	of organic matter to improve soil fertility and	CEC (me/100 g) 14.33 Water (%) 72.90 60.63	
	production of Z. montanum. Several research workers demonstrated the positive effects of animal manure		
	on the physical, chemical, and biological properties	The manure was applied evenly according to the	~
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			the incubation time. The hi	ghest incre	ase in P in	the pr	ovided an inc	rease in cati	on exchange	capacity. The						
			soil was obtained due to manure at 60 t/ha (Table 6)	The resul	ts of this st	tudy ob	tained due to	the addition		capacity was are at 60 t/ha,						
			indicated that the addition	of all lev	els of ma	nure as	shown in Ta	ble 7.								
1			Table 2. Soil pH after manu	re treatmen	t.											
			Manure Treatments				pH Week of Inc	ubation								
			Control	0	3	6 5.62	9 5.61	12 5.62	15 5.62	18						
			Cow manure 20 t/ha	6.40	6.20	6.00	5.80	5.70	5.70	5.60						
			Cow manure 40 t/ha Cow manure 60 t/ha	6.50 6.80	6.40 6.60	6.30 6.40	5.90 6.60	5.70 6.20	5.50	5.40 5.80						
			Chicken manure 20 t/ha	5.83	5.60	5.40	5.00	4.83	4.70	4.51						
			Chicken manure 40 t/ha	6.04	6.00	5.80	5.04	4.74	4.90	4.80						
			Chicken manure 60 t/ha	6.08	5.43	5.08	4.76	4.77	4.08	4.21						
			Table 3. Soil organic C after	manure tr	eatment.											
			Manure Treatments				Organic C Veek of Incu	bation								
			Control	0.18	0.18	6 0.18	9	0.18	0.18	0.17						
			Cow manure 20 t/ha	0.83	0.80	0.78	0.64	0.56	0.46	0.40						
			Cow manure 40 t/ha Cow manure 60 t/ha	1.31	1.27	1.20	1.19	1.08	1.07	1.01						
			Chicken manure 20 t/ha	0.36	0.33	0.32	0.30	0.27	0.21	0.18						
			Chicken manure 40 t/ha Chicken manure 60 t/ha	0.42	0.42 0.98	0.41 0.95	0.38	0.35	0.31 0.80	0.26 0.78						
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G Acco	eptance Lette	er (PALUPI et al	Chicken manure 20 t/ha Chicken manure 40 t/ha Chicken manure 60 t/ha	0.36 0.42 0.98	0.33 0.42 0.98	0.32 0.41 0.95	0.30 0.38 0.92 N (%)	1560-PALUP Find text or 0.27 0.35 0.87 bation	I et al -GP (tools Q 0.21 0.31 0.80	× + Cre 0.18 0.26 0.78	ate				- C	ס
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		better than soils with le elements are in the soil a				held and is e	asily lost. Th ing soil org	is condition	was re	flected				
9		does not quickly lose or v	ash away	these nutrie	nts. trea	atment with	manure appli in the trea	cation. It die	l not it	crease				
2		Mineralization of soil or limited supplies of N.	S, and r	nicronutrie	nts; app	plication, an	d vice versa.	This study	show	ed that				
1		during mineral dissolution reactions, re-supply P	K. C.	a, Mg.	and of	chicken a	of giving organd cow n	anure gav	sign	ificant				
2,		micronutrients. Nutrier influences ion transport t	o plant roo	ots, evaluat	tion of	leaves, root	olant height, length, fresh	weight of a	hizom	es, and				
Q.		of nutrient availability t nutrient management de	cisions (H	Havlin, 201	20). aff	fected signifi	rhizomes. C cantly by the	treatments.	For g	owing				
2		The nutrient added to the			not zin	igiber, N, P,	and K play a	s essential nu	trients					
		Table 6. Soil available P af	fr manure i	treatment.		P (ppm								
		Statute Freaking	0	7	6	eek of Incu	bation 12	15	1	_				
		Control	10.52	10.52	10.52	10.52	10.51	10.52	10	.52				
		Cow manure 20 t/ha Cow manure 40 t/ha	0.40	0.36 0.40	0.36 0.42	0.43	0.44	0.45	0	.45				
		Cow manure 60 t/ha Chicken manure 20 t/ha	0.44 12.78	0.44 12.78	0.45 12.8	0.47 12.81	0.48 12.90	0.48 12.92	12	.49 .93				
		Chicken manure 40 t/ha Chicken manure 60 t/ha	13.42 15.68	13.44 15.68	13.47 15.68	13.48 15.69	13.49 15.70	13.49 15.72		3.5				
		Table 7. Soil CEC after ma	une treatm	ént										
		Manure Treatments				CEC (me/1								
		-	0	3	6	veek of Incu 9	12	15		8				
		Control Cow manure 20 t/ha	14.33 19.15	14.33 19.15	14.32 19.17	14.33 19.17	14.34 19.18	14.33 19.18	19	.33 .19				
	e here to search	Cow manure 40 t/ha	19.35	19.36	19.36	19.37	19.37	19.38		.38 26°C (0 4	. 23:35
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		Manure Treatments			W	CEC (me/1 Veek of Incu	bation							^
		Control	0 14.33	3 14.33	6 14.32	9 14.33	12 14.34	15 14.33	14	.33				
3		Cow manure 20 t/ha Cow manure 40 t/ha	19.15 19.35	19.15 19.36	19.17 19.36	19.17 19.37	19.18 19.37	19.18 19.38	15	.19 .38				
		Cow manure 60 t/ha	20.45	20.45 18.32	20.46	20.50	20.51	20.55	20	.56				
1		Chicken manure 20 t/ha	18.32	18.34	18.33	18.34	18.37	18.38						
2			18.32 18.38 19.00	18.32 18.38 19.12		18.34 18.41 19.15		18.38 18.44 19.20	18	.40 .45 .22				
		Chicken manure 20 t/ha Chicken manure 40 t/ha Chicken manure 60 t/ha	18.38	18.38	18.33 18.40 19.14	18.34 18.41 19.15	18.37 18.43 19.18	18.44 19.20	18 19	.45				1.1
		Chicken manure 20 t/ha Chicken manure 40 t/ha	18.38	18.38	18.33 18.40 19.14 hig	18.34 18.41 19.15 ghest dose of ight of 42.78	18.37 18.43 19.18	18.44 19.20 yielded an	18 19 averag	.45				
		Chicken manure 20 tha Chicken manure 40 tha Chicken manure 60 tha Plant growth Plant height Table 8 shows that when	18.38 19.00	18.38 19.12 was about	18.33 18.40 19.14 hig hei six	18.34 18.41 19.15 ghest dose of ight of 42.78 unber of tille	18.37 18.43 19.18 Cow manure cm at 18 we	18.44 19.20 vielded an eks after plat	18 19 averag iting.	.45 .22 e plant				
		Chicken manure 20 tha Chicken manure 40 tha Chicken manure 60 tha Plant growth Plant height Table 8 shows that when weeks old, the application - 60 tha produced the best	18.38 19.00 the plant f cow man plant grow	18.38 19.12 was about ure at a dos rth (26.16 c	18.33 18.40 19.14 hig hei six e of Tal m), fou	18.34 18.41 19.15 thest dose of ight of 42.78 <i>iniber of tille</i> , ble 9 shows and at a dose	18.37 18.43 19.18 Cow manure cm at 18 we rs that the high of 60 t/ha of	18.44 19.20 vielded an eks after plan test number f chicken mr	18 19 averag iting. of tille nure, v	.45 .22 e plant rs was vith an				
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		Chicken manure 40 t/ha	1.50 c	4.00 b	6.65 c	8.45 bc	12.151	ic						
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	affect the root les	ngth of the b	angle plant. The cl ided the lowest rh	hicken 60 t chicken izome weight of 13:	manure /ha with an	n average	rhizome	dry				
j.	fresh weight of :	392.35 g. In	comparison, the c was not signifi	ontrol	etabolic level							
	different from 2	0 t/ha and 4	0 t/ha cow and cl	hicken The results o	of the secondary m							
9			of the bangle rh of 40 t/ha chicke		oangle rhizome nd tannin-containi	contained ng active	d pheno substan	lic, ces,				
2			lifter significantly cation of 60 t/ha cl		oids, alkaloids, and the compounds							
1	manure. The trea	tment of 60	t/ha cow manure y	ielded metabolism j	presented in Table	12 show	that, des	pite				
	was significant for	or all treatme		compound a	ame amount of content of the b	angle rh	izomes	was				1.0
4			of bangle rhizom en manure treatme		n the rhizome wa opposed to when							
	dose of 20 t/ha,	respectively	\$6.00 g for cow n	anure fresh. The ar	mount of chicken	manure th	hat produ	ced				
	These values wer	re lower than	icken manure trea that of the contro	l, with fresh and d	phenolic content i ry conditions, co	rrespondi	ngly aro	ind				
	an average of insignificantly of	93.75 g. lifferent rhi	The control y zome dry weight		and 202.79 mg/L of chicken manure							
	chicken manure	at 20 and 40	t/ha, cow manure manure at 60 t/l	at 20 levels of ac	tive flavonoids an noarison with the f	d tanning	s than o	her				
	yielded significa	untly differe	nt rhizome dry	weight control had t	he lowest active co	ompound	content.	The				
	with the best do average rhizome	ose of 60 t/l dry weight	ha cow manure w of 179.75 g, follow	ith an plant yields o red by than those of	of the cow manure the chicken manur			wer				
				root length and rhizome	weight							
	Manure Treat		Root length (cm)	Rhizome fresh weig	CODA PROVINCE	me dry w	eight (g)					
	Control Cow manure 20	tha	31.90 ab	415.25 ab 444 75 ab		93.75 a						
	Cow manure 40	t/ha	35.36 b	530.00 bc		119.00 a	ь					
	Cow manure 60 Chicken manure		36.50 b 33.20 ab	822.00 d 393.25 a		179.75 c 78.25 a						
	Chicken manur		38.95 b	487.50 abc		99.75 a	b					~
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		int of Degrades and still	1000		1,0000-0000	(=0=3)							^
	Antioxidant Results of antioxidant analysis	of bangle rhizomes	Discussion Effect of ma		tion on soil	chemical							
P,	based on fresh and dry rhizome 13. IC ₅₀ value obtained descr	are shown in Table	properties	unure uuur	uon on sou	cnemicui							
2	sample captured free radicals.	The dose of chicken	The change during the in	es in seve neubation o	ral soil ch	emical pa	rameters I manure						
	manure of 60 t/ha was found to value of 9.52 ppm in the fresh	a sample, while the	are presented the analysis	d in Table	2, 3, 4, 5 a	nd 6. Acco	ording to						
2	control gave the highest IC ₅₀ va the fresh rhizomes. The same	quality was obtained	soil chemica by the differ	al characte	eristics were	e strongly	affected						
SI,	for the dry rhizomes. The ap manure of 60 t/ha produced the l	owest IC30 value, and	There were incubation	e significa	int differen	ices betw	een the						
2	the largest was in control. The i of variance (ANOVA) at a 5% l	evel showed that the	exchangeabl	le acid an	nd base ca	tions, CE	C, base						
-	treatments of giving organic fert chicken and cow manure gave s	ilizers in the form of gnificant differences	saturation (p parameters	(e.g., pH	H ₂ O, pH	KCl, org	tanic C,						10
	in plant height, number of tiller root length, fresh weight of rhize		exchangeabl statistically l	high value	s and concer	itrations in	the first						
	of rhizomes. The treatments of affect root length.	lid not significantly	two weeks, weeks,	which dec	reased in th	e next four	r and six						
	Table 13. Antioxidant based on I	C50 value.											
	Antioxidant (IC50) (mg/L)		Manure Tre	eatments (
		20	ow Manure 40	60	20	en Manur 40	60						
	Fresh rhizomes Dry rhizomes	53.58 48.55 40.91 38.30	47.36 34.78	47.14 34.46		27.42 14.05	9.52 8.06						
	Note: The smaller the IC50 value, th	e stronger the antioxidant.											
	The increment in incubation time an inconsistent effect on the soil.		grow. Comp typically p										
	reported that utilizing organic r	nanure to meet crop	application	of chick	ken manu	e at all	levels						
	nutrient requirements would practice to enhance sustainable	agriculture. This is	significantly planting, bu		eeks, the pl							23:36	~
	Lampiran II - Daftar Penerima	Lampiran I - Daftar Per	nerima P		ALUPI et al -		+ Cre	ite				-	٥
Acceptance Letter (PALUPI et al., tools Edit Convert E-Sign			nerima P		ALUPI et al - xt or tools		h	ē	ଜ	Ø			5
	Note: The smaller the IC50 value, th	e stronger the antioxidant.		Find te	xt or tools	Q E	ቀ	•	ଦ୍	Ø		- 1	-
tools Edit Convert E-Sign	Note: The smaller the IC50 value, th The increment in incubation time an inconsistent effect on the soil.	e stronger the antioxidant. seemingly exhibited Adekiya et al. (2020)	grow. Comp typically p	Find te pared to a produced	xt or tools f thicken mathematic	Q E	manure h. The	ate)	¢	P		- 1	-
	Note: The smaller the IC50 value, th The increment in incubation time an inconsistent effect on the soil, reported that utilizing organic r nutrient requirements would	e stronger the antioxidant. seemingly exhibited Adekiya et al. (2020) nanure to meet crop be an unavoidable	grow. Comp typically p application significantly	Find te pared to a produced of chick r increased	xt or tools chicken ma better pla ken manu plant heigl	Q E nure, cow nt growt e at all ut at 9 we	manure h. The l levels eks after	ē	¢	Ø		- 1	5
tools Edit Convert E-Sign	Note: The smaller the IC50 value, th The increment in incubation time an inconsistent effect on the soil, reported that utilizing organic - nutritent requirements would practice to enhance sustainable because the physical, chem	e stronger the antioxidant. seemingly exhibited Adekiya et al. (2020) anture to meet crop be an unavoidable agriculture. This is cal and biological	grow. Comp typically p application significantly planting, bu decreased. I	Find te pared to a produced of chici v increased at at 12 w In the 20 t	xt or tools ¹ chicken mai better pla ken manu plant heigl eeks, the pl /ha chicken	Q E nure, cow nt growt e at all it at 9 we ant height manure fi	manure h. The l levels eks after slightly reatment.	ete 🕞	¢	I		- 1	-
tools Edit Convert E-Sign	Note: The smaller the IC50 value, th The increment in incubation time an inconsistent effect on the sol- reported that utilizing organic r autrient requirements would practice to enhance sustainable because the physical, chemi properties of soil are generall addition of organic manner, while	e stronger the antioxidant. seemingly exhibited Adekiya et al. (2020) be an unavoidable agriculture. This is cal and biological y inproved by the ich in turn enhances	grow. Comp typically p application significantly planting, bu decreased. It the plant he weeks after	Find te pared to a produced of chicl int at 12 w In the 20 t eight was a planting a	thicken mai better pla ken manu plant heigl eeks, the pl /ha chicken n average nd decrease	Q E mure, cow nt growt re at all at all ant height manure fu of 30.16 c ed in the f	manure h. The l levels eks after slightly reatment, m at 12 ollowing	e le	ଙ୍କ	P		- 1	-
tools Edit Convert E-Sign	Note: The smaller the IC40 value, th The increment in incubation time an inconsistent effect on the soil, reported that utilizing organic practice to exhaus constantions, would properties of soil are generall addition of expansic manares, who ecop productivity and maintains productions. Poulty, little returns	e stronger the antioxidant. seemingly exhibited Adekiya et al. (2020) be an unavoidable agriculture. This is cal and biological y improved by the ch in turn enhances the quality of crop ents were positively	grow. Conq typically p application significantly planting, bu decreased. Is the plant he weeks after weeks. A hii manure (0.3	Find te pared to a produced of chici v increased at at 12 w In the 20 t eight was a glanting a glanting a 38%). Alth	thicken mar better pla ken manu plant heigl /ha chicken an average nd decrease a content wa oough the a	Q Entry of the second s	manure h. The l levels eks after slightly eatment, m at 12 ollowing chicken nitrogen		¢	Ø		- 1	-
tools Edit Convert E-Sign	Note: The smaller the IC40 value, th The increment in inclusion time inclusion time an inconsistent effect on the soil, reported that unitizing organic, the protective to solve are generally properties of sol are agreenal solution error productivity and maintaining production. Doubly lifter trade corp productivity and maintaining production. Doubly lifter trade corp productivity and maintaining conclusion.	e stronger the antioxidant. Adekiya et al. (2020) nature to meet crop be an unavoidable agriculture. This is cal and biological y improved by the chin turn enhances the quality of crop ents were positively ity levels, as well as versity. These results.	grow. Comp application significantly planting, bu decreased. I the plant he weeks after weeks. A hij manure (0.3 required by nutrients, a	Find te produced of chici y increased at at 12 w In the 20 t eight was a planting a glanting a glanting at deficienc	thicken mai better pla ken manu plant heigi eeks, the pl ha chicken m average nd decrease a content wa ough the a s always j y or exces	Q E nure, cow nt growt e at all at at 9 we ant height manure th of 30.16 c d in the f as found in mount of higher thas s of nitro	manure h. The l levels eks after slightly eatment. m at 12 billowing chicken nitrogen m other gen can		¢	P		- 1	-
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-	increase of 37.61 cm. When compared to the other two doses of chicken manure, the plant height for the	the number of	that there was a noticea tillers at 18 WAP of age	A plant i	needs					
<u>,</u>	60 tha chicken manure was different. The plant height increase over 18 weeks	nutrients for growth and	its physiological pro development. Plant	cesses d growth	uring and					
2	demonstrates this, but the increase in plant height was typically not too different from the previous weeks.		Il be subpar due to a la 2014). Organic matter							
2	Even though the application of cow manure at a dose of 40 t/ha initially produced fewer yields than that	biological bu	ffer so that the soil can I nutrients (Nair, 2019).	supply p	lants					
	produced by the application of chicken manure at a dose of 40 t/ha, at the end of the observation at 18	topsoil, increa	ising water absorption an fertility are all importan	nd storage	, and					
l	weeks, the increase in height was more apparent and	manure (Murj	ohy, 2015). A sudden rise	in the nu	mber					
L	might even have exceeded that of the chicken manure at a dose of 40 t/ha, which caused a decrease in plant	shoots can em	result from the ease wi erge from loose, moist so	il.						
	height. The addition of cow manure improves soil	fewer and nes	start of planting, there urly identical numbers of	tillers in	each					
	permeability, total pore space, aggregate stability, bulk density, texture, color, and temperature (Shrinet		e nutrients in this fert ble to plants, which is th							10
	et al., 2021). A dose of 60 tha of chicken and cow manure had the tendency to produce steady.		owth at the start of the p ineralization or decompo							
	dependable results. The application of cow manure at a dose of 60 tha tended to yield less than chicken	materials ha	s a significant impact he low nutrient availabili	t on nu	trient					
	manure at doses of 40 and 60 t/ha from the start of	partially caus	ed by the presence of N	, P. and	other					
	planting until the plant was 9 weeks old, but the yields increased in the following weeks. The plant's	to decompose	complex compounds that a (Cui et al., 2022). At	6 weeks	after					
	need for nutrients grows as it ages. If the nutrient requirements are not met, and the nutrients are not	differences b	reatments tended to be s etween the tillers in e	ach treat	ment					
	readily available, plants may get nutrient deficiency at specific times (Bindraban et al., 2015).	of 60 t/ha wa	ninimal. Although cow m s the best dose, with an a	verage nu	mber					
	Bangle plants absorb N (0.06-3.07 g), P (0.01- 0.53 g), and K (0.10- 2.25 g) at 2 to 10 months after		14.45 tillers, chicken ma er results than cow manu							
	planting in the canopy. N is the nutrient that is most required in the plant canopy itself. The primary	dose. In com	parison to other manure a at 12 weeks after play	doses, chi	icken					
	nutrient for plants, nitrogen, is typically essential for the development and expansion of vegetative parts of	the best result	s with 6.65 tillers.	nui proc						~
Acceptance Letter (PALUPI et al.	Lampiran II - Daftar Penerima Lampiran I - Daftar Pen	nerima P ోగ్ల	1560-PALUPI et al -GP (. × [·	+ Creat	e)			- 0	p
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	at specific times (Bindraban et al., 2015). Bangle plants absorb N (0.06-3.07 g), P (0.01-	of 60 t/ha war of tillers of	Find text or tools Q the best dose, with an a 14.45 tillers, chicken ma	verage nu nure typi	mber	-	B <i>P</i>		_	5
	at specific times (Bindraban et al., 2015). Bangle plants absorb N (0.06-3.07 g), P (0.01- 0.53 g), and K (0.10- 2.25 g) at 2 to 10 months after planting in the canopy. N is the nutritent that is most	of 60 t/ha wa of tillers of produced bett dose. In com	Find text or tools Q the best dose, with an a 14.45 tillers, chicken ma parison to other manure	verage nu mure typi ire at the doses, chi	mber ically same icken	-	B. P		_	5
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2	sufficient amounts in manure. The related observation variables will be impacted by the food's growth	4.86. Al is commonly excessive in acidic soils, and it can poison plants and bind phosphorus (P). Low soil			
<u>j</u>	quality and planting age. In relation to the addition of the number of	pH can hinder plant growth by preventing the roots from properly absorbing nutrients. As Mažeika et al.			
2	leaves, the most influential element is N. In comparison to other nutrients, nitrogen is required in	(2021) demonstrated, giving chicken manure can maintain stable nutrient content in soil and minimize			
*	sufficient amounts for plant growth. N makes up 40-	mineral fertilizer influx into the environment. This			
2	50% of the dry weight of protoplasm, the living component of plants (Kathpalia and Bhatla, 2018).	can raise the pH of the soil. By raising pH, Al in the exchangeable form will be reduced, and nutrients will			
1	Since protein is the source of all plant enzymes, nitrogen participates in all enzymatic processes in	become more available to plants. According to Rosita et al. (2005), nutrient			
	plants. Additionally, nitrogen is one of the constituent	uptake on the roots of bangle plants at 2-10 months			
L	elements of chlorophyll, the primary component of chloroplasts, and it contributes to improving the	after planting is as follows: N (0.01-0.52 g), P (0.002- 0.15 g), and K (0.02-0.82 g). It is discovered that the			
	quality and quantity of the dry matter produced (Wen et al., 2020). Fertilizer use and the amount of	roots of the bangle plant has more K buildup than N and P. K is primarily used to aid in the synthesis of			
	nutrients in the soil have a significant impact on how plants grow and develop. Nutrient uptake is restricted	proteins and carbohydrates. In the face of drought, illness, and pests, potassium gives plants strength			
	by nutrients in a minimum state (Purba et al., 2021).	(Hasanuzzaman et al., 2018). Organic fertilizers can			
	In terms of the addition of leaves, the treatment of plants without fertilizer differed significantly enough	help the soil's physical and chemical composition, which will facilitate root development. Up until the			
	for each observation. In comparison to other treatments, plants without fertilizer produced the	soil reaches its critical water potential, plant roots expand into moist soil and draw water (Sisouvanh et			
	lowest yield.	al., 2021). The looseness of the soil can promote root development. Strong roots will make it simpler for			
	Root length	plants to absorb nutrients and water.			
	The lowest root length was observed for the 20 t/ha cow manure treatment, with an average root length of	Rhizome fresh weight			
	about 24.36 cm, which was lower than the control. With an average root length of 41.03 cm, the	Plant biomass is a common parameter used to study plant growth. When plant nutrient requirements are			
	application of chicken manure yielded the longest	met, yields will be optimal (Timsina, 2018). The			
	roots. When plants respond to water shortages by reducing the rate of transpiration to conserve water,	rhizome of the bangle plant is the most advantageous			
		part of cultivation. One could also argue that this			
	the roots play a cucial root (Source et al., 2017).	part of cultivation. One could also argue that this rhizome's fresh weight is a crucial factor in 1 1 1 1 1 1 1 1 1 1	rah ^ 🖲 🕻	4 -	각비 23:37 각비 31/05/2024
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	organic matter soils will have more severe damage to	beneficial microorganisms that encourage the		
a,	the soil's structure (Murphy, 2015). When the soil does not receive enough water and becomes dense	breakdown of organic matter and release inorganic nutrients that are then available for plant uptake.		
	and hard, soil damage is evident. Plant rhizomes will not be able to grow or spread out in compacted or	Organic fertilizers can help to create ideal conditions in the soil for microorganisms that are beneficial to		
2,	hard soil. The ability to maintain loose soil conditions	plants (Du et al., 2022). Chicken manure is an organic		
2	that are difficult to harden or compact increases with the amount of organic matter added. Additionally,	fertilizer with high nitrogen content, despite not being the best dose for bangle rhizome weight yield. As		
SI.	manure helps to improve soil structure, cation exchange capacity, and water resistance. Giving	they ensure the best nutrient management for plants, such fertilizers should be used promptly to partially		
	manure has the indirect effect of making it simpler to keep water in the soil (Zhang et al., 2016). Since	replace chemical fertilizers (de Araujo Guimaraes et al., 2019).		
2 _	water availability plays a significant role in plant growth, water frequently restricts the growth and development of cultivated plants. The plants will	Secondary metabolic levels (phenolic compounds, flavonoids and tannins)		
	experience drought conditions if there is not enough water in the soil. Due to decreased primary	The results of laboratory analysis showed that the positive bangle rhizome contained compounds in the		
	metabolism, reduced leaf area, and decreased photosynthetic activity, drought stress can lower plant	form of phenolics, tannins and flavonoids. These compounds responded differently to the concentration		
	productivity (biomass). Smaller leaves grow due to a lack of water during the vegetative stage, which can	of organic fertilizer applied in the form of cow manure and chicken manure. According to Table 12.		
	reduce light absorption.	the amount of tannin compounds increased as manure		
	Lack of water also inhibits the synthesis of chlorophyll and some enzymes, such as nitrate	dosage rose. The application of chicken manure or cow manure with three doses of 20, 40, and 60 t/ha		
	reductase, from working (Altuntaş et al., 2020). Organic substances in the soil may have	increased the tannin concentration in the rhizome as the dose increased. When compared to cow manure,		
	physiological effects on plant growth that are direct or indirect (Basilio et al., 2013). Compared to other	applying chicken manure produced significantly better results. It is evident that the application of 20 t		
	types of manure, chicken manure contains a fair amount of P. This is due to the fact that chicken	chicken manure/ha resulted in a higher tannin concentration than that of 60 t cow manure/ha.		
	manure contains feed (Agbede, 2021). Phosphorus aids in the growth of plant roots, photosynthesis,	Dry rhizomes produced a higher concentration of tannins than fresh rhizomes, which produced		
	transfer respiration, cell division, and growth (Malhotra et al. 2018). The number of cells increases	different results regarding tannin concentration. The concentration of tanning in fresh thizomes increased		(1997)

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	or indirect (Basilio et al., 2013). Compared to other types of nanure, chicken manner contains a fair amount of P. This is the to the fact that chicken manner contains field (Azhelec, 2011). Phosphorus aid, in the growth of plant roots, phonymheixic, (Malhort et al., 2015). The multiple of cells increases more quickly when they drived quickly, which causes the rhizomes to grow larger. Rhizome dry weight The dry weight reflects a plant's notificionally, the collected data, it was found that applying chicken and collected data, it was found that applying chicken and constrained different from the control. This is the active vegetative formation stage. The is the active collected that on the other does demonstrated different routin and timing of tertilizer applied can impact copy yields, monoge other things. Organic matter plays a encial role in soil health because it as careles table soils agregaters. increase soil fertilizy and serve as a source of neurgy for collected on the observed approximation that the source of plant and the other doese of in chicken manuter. The annount and timing of fertilizer soil fertilizy and serve as a source of neurgy for soil metal cores or pield and improves core quality of the matter copy pield and improves core quality of the composite of the other sources the coll increases copy pield and improves core quality of the other doese of the composition of the plant of the other sources the colline creases copy pield and improves core quality of the other doese of the other more sources of the other more reduces the colline creases copy pield and improves core quality of the other doese of the other more sources of the other more sources of the other doese of the other more sources the composite of the other more sources of the other more sources of the other more s	spectra results, its evident that the application of 20 thicker manure ha resulted in a higher tamin of the second state of 0 (core manure has. Dry hitcomes produced a higher concentration for manins that for 0 (core manure has. Dry hitcomes produced a higher concentration on second states and the hitcomes increase increases and the states of the second states of the second states of the second states of the second manuse that increases with the difficient of the second the disse of core manure and comparison to the tuse of the hitcomes detected field and the second states of the disse of core manure and the second states of the second states of the second states of the second the disse of core manure and the second states of the second provided the lowest tamin are an antitigated the field states of the second test as antitigated the disers shares the theory ones are an antitigated the disers shares the theory ones and the second disers along the theory taming and an antitigated the disers shares the theory ones and the antitochical disers along the theory taming and the distribution of the second states of the second test as controlling substances in plant tratbolical activity is a the type of tamin substates and matimization is a distribution and the effective of trates with tamin cisci. Additionally, tamic cale childs antimization is populsing commic field like in the form of cover and physical companies field like in the form of cover and physical companies. The theory is the distribution of the		

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			compounds. The content of ac simplicial is impacted by			cing 50% of DPP ioxidant activity.						
<u>,</u>			Antioxidant activity is influ- phenolic and flavonoid con			, 2018). Antioxid or neutralize fr						
2			Sanatombi, 2020). The hi			ain diseases caus						
2			flavonoid concentrations were rhizomes when chicken many			017). The treatme ible 13 resulted i						
2			t/ha. Applying cow manure of	of 60 t/ha resulted in	chicken manure	. The antioxidant	activity of the	he dried				
1			phenolic compound concentrat the fresh rhizome and 181.			es was higher that highest antioxi						
Q.			rhizomes, while flavonoids we	ere 71.14 mg/L in the	produced by co	w manure at a dos	e of 60 t/ha,	with an				
4			fresh rhizomes and 99.43 mg/ Compared to chicken manure			.52 ppm for fresh zomes. At a dose						
•			result was smaller. A dose of 6	60 t chicken manure/ha	fresh and dry r	nizome conditions	, cow manus	re had a				
			resulted in phenolic compo- 178.56 mg/L in the fresh rhize			ue than chicken eatment without fo						
			in the dry rhizomes. The conc	centration of flavonoid	IC50 value of	around 53.58	opm, and					
			in fresh rhizomes was 104.39 rhizomes was 181.91 mg/L.	mg/L, and that in dry		around 40.91 ppr (2018) claimed		iovidant				
			In plants, flavonoids service		activity in ban	gle rhizomes is i	ncredibly p	owerful.				
			flowers, fruits, and roots and e regulators and disease resistance			treatment without ons, the IC 50 value						
			Catechins are one class of	flavonoid compounds	in all treatment	s gave a value of	50 and inc	luded a				ė
			present in bangle rhizomes have antioxidant properties, a			antioxidant. The sounds found in t						
			stop the growth of viruses,	bacteria, tumors, and	are inextricabl	y linked to the	high ant	ioxidant				
			fungi, they can also get rid of r (Isemura, 2019). Phenolic com			lary plant metabo play a part in a						
			that plants make in response to	o environmental stress.	More phenolic	compounds will ha	we a higher					
			Phenolic compounds protect D and damage by blocking UV-		antioxidant acti	rity (Tohma et al.,	2017).					
			(Takshak and Agrawa, 2019).	Gallic acid is the type	Conclusion							
			of phenolic compound found Gallic acid serves as an a			lose of 60 t/ha wa					100	

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▼ ₽. ₽. ₽.	(hemura 2019). Phenolic compounds are compounds that Jahas make in response to environmental stress. Phenolic compounds protect D2A from dimerization (Takhak and Agrawa. 2019). Gallic acid is the type of phenolic compound found in bungle thiconess- Gallic acid serves as an ambscterial, matrixinal analgesis; and mitodami in medicine (Shirnet et al. 2021). The application of checken namure renuled in a halter compound format in bungle thiconess than a stress as an ambscterial, matrixinal analgesis; and mitodami in medicine (Shirnet et al. 2021). The application of checken namure renuled in a halter comparison of the second probability of the analgesis and mitodami in the form of a halter comparison of the second probability of the theory of the second probability of the second probability than other namure (Alimoid et al. 2020). Houphorus frame formation in DNA, RNA, and the parts of micloridies that provide matholic energy (ikk ATP). The process of secondary metholsism in the form of tumins, phenolic compounds, and firevonoids is infranced by the difference in the Partient content between these two types of manure. Environmental factors affect the levels of flavoroids in othe form of temperature, numerian availability, water availability, and atnospheric CO ₂ concentrations (Adund et al. 2018).	sad phenolics phy a part in antioxidant activ More phenolic compounds will have a higher leve minoxidant activity (Toluma et al., 2017). Conclusion A cow manuer does of 60 that was the best does fa <i>montaming movies</i> , with an average height narcease 42.78 cm, an increase in the number of lavers 16.65 piece, and an increase in the number of lavers of 14.45. A chicken means does of 00 tha produ- fication are also and a set of the set of the set and the set of the set of the set of the set and a set of the set of the set of the set and a set of 0.11 har set of the set of the set and the set of 0.11 har set of the set of the set and the set of 0.11 har set of 0.12 har set and the set of 0.11 har set of the set of 1.15 har set and the set of 0.11 har set of 0.11 har set indexing day the set of 0.11 har set indexing day the set of 0.12 har set through of 1.13 µ mgL. The application of chicken manuer at a 80 tha does resulted in highest minim. The application of 1.04 har set 9.52 ppm in the fresh thirones and 8.06 ppm in day through the set of the set of the set of 1.01 har set 1.01 har set of 1.01 har set of 0.01 har set of 0.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set 1.01 har set of 0.01 har set of 0.01 har set	e Z of of of of the muse of 7.5 ken est til 3.3 J f f f f f f f f f f f f f f f f f f	1 ~ 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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	The antioxidant activity analysis produced different IC 50 values depending on the type of organic fertilizer	Acknowledgements		
	used (Table 13). The IC ₅₀ decreased as the fertilizer dose increased. A concentration known as IC ₅₀ is	This study was funded by the Ministry of Educat Culture, Research and Technology, of the Republic Indonesia, as part of the scheme of Higher Education	of	
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