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# The Effect Of Chicken Manure And Biochar Application On The Growth And Yield Of Cauliflower (Brassica oleraceae Var. Botritys L)

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***Abstract***
*Field research was carried out in Raifun village-Maliana Timor Leste from September 2023 to January 2024 at 226 meters above sea level, aiming to determine the effect of chicken manure and biochar on the growth and yield of cauliflower plants.*
*This study used a Randomized Complete Block design (RCBD) that was repeated three times in 3 blocks. the first factor in this study is chicken manure which consists of 3 levels of treatment, namely: without chicken manure (M0), chicken manure dose of 10 t $h^{-1}$ (M1), and chicken manure with a dose of 20 t $h^{-1}$. The second factor is biochar which consists of 3 levels of treatment, including: without biochar (B0), biochar 5 t $h^{-1}$, and biochar 10 t $h^{-1}$.*
*The results showed that there was an interaction between the two factors in the parameters of plant height, flower weight per plant, and flower weight per hectare. the highest production per hectare was obtained by a combination of a chicken manure treatment dose of 20 t $h^{-1}$ and a biochar dose of 10 t $h^{-1}$ of 19.1667 tons. The lowest production per hectare was achieved by a combination of treatments without the application of chicken manure and biochar amounting to 9.1733 tons.*
***Keywords:*** *Chicken Manure; Biochar; Growth; Yield; Cauliflower*

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## I. Introduction

Cauliflower (*Brassica oleraceae var. Botritys* L.) is one of the horticultural plants categorized as vegetable plants that have white flowers. Cauliflower belongs to the family Brassicaceae (Sunarti, 2014). In addition, cauliflower is also famous as a plant that has aloft economic value compared to other vegetable crops (Fitriani, 2009). Therefore the majority of people in the world grow and consume cauliflower as a vegetable that is rich in nutrients, vitamins, and minerals.

Cauliflower thrives in countries of subtropical such as Europe, China, Japan, and Korea. The aloft economic value led to the spread of this plant through trade and distribution activities to African and Asian countries (Fitriani, 2009). Cauliflower plants contain 93% water in all plant organs such as stems, leaves, and flowers. In addition, cauliflower also contains some nutrients calcium 2%, potassium 2%, phosphorus 6%, magnesium 4%, iron 3% no fiver 2.0%, and is a source of vitamins A, B, and C. This plant is also important for human health including anticipating attacks of bone disease, heart, cancer, eye, stomach, and asthma, therefore it is important to cultivate (Dellah, 2023).

Cauliflower plants have been cultivated in small quantities in East Timor, although they haven't yet achieved optimum production. Cauliflower cultivated in several regions of Timor Leste has an average production per hectare of only 11.95 t $h^{-1}$ (Correia, 2022). The amount of production mentioned is still very low when compared to the average cauliflower production in other countries such as Indonesia, which is 12.08 t $h^{-1}$ (Edduard et al., 2020). Organic matter is a soil improvement material derived from plant and animal residues. Some organic materials that are very important for improving the physical, chemical, and biological properties of the soil are manure and biochar, chicken manure that has sufficient nutrient content is one of the manures for plant growth and yield. In addition to manure, organic matter that is rich in carbon is biochar which has a role in neutralizing soil acidity and be able to bind water in the soil, Cauliflower production that did not increase from year to year in Timor Leste is due to the absence of knowledge about the use of appropriate technology, including the use of chicken manure and biochar organic material so that production could be increased. Therefore, it is necessary to study the application of chicken manure and biochar material as one of the

technologies in increasing cauliflower production.

**Objectives**

The objectives of this research are :

-To know the effect of chicken manure on the growth and yield of cauliflower

-To know the effect of biochar on the growth and yield of cauliflower

-To know the effect of interactions of chicken manure and biochar on the growth and yield of cauliflower.

## II. Research Methods

**Site and Time**

An experimental trial was conducted in Maliana Sub District, Bobonaro Municipality from September 2023 to January 2024.

**Material and Equipment**

Materials and Equipment used in the research are the seed of cauliflower, chicken manure, biochar, line meters, analytic balance, pH tester, rules, manual balance, sword, hoe, crowbar, hammer, bucket pipe, oven, thermometer, triplex, nail, dendrometer, caliper, string of raffia.

**Experimental Design**

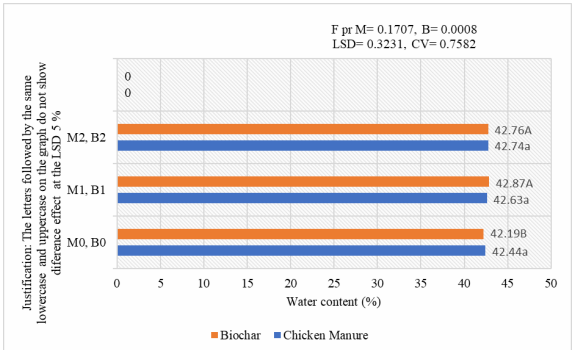
The agronomic trial was a Randomized Complete Block Design (RCBD) with two factors. The first factor was chicken manure (M), consisting of 3 treatment levels, M0= without chicken manure (0 t/ha), M1= application of chicken manure doze 10 t $h^{-1}$, M2= application of chicken manure doze 20 t $h^{-1}$. The second factor was biochar (B), consisting of 3 treatment levels, B0= Without biochar (0 t/ha), B1= application of biochar doze 5 t $h^{-1}$, B2= application of biochar doze 10 t $h^{-1}$. The treatment combination was established at 3 blocks. Each block had 9 plots. The Parameters observed were water content, the plant height, the number of leaves, the weight of flowers per plant, and the weight of flowers per hectare. Other than these above treatments, all other crop-specific were employed across treatments i.e., land preparation, crop care, and management were similar to common farming practices of Maliana farmers.

**Data Analysis**

The data observed had been analyzed variation (ANOVA) to indicate the interaction between 2 factors and significant differences. Furthermore, to compare each other treatments using LSD 5 % level. The media utilized in statistical analysis were software STAR 2.1 IRRI.

## III. Result And Discussion

The results of ANOVA showed the interaction between chicken manure and biochar on the number of leaves at observation 2 weeks after planting, plant height, flower weight per plant, and flower weight per hectare. The result of the statistical (picture 1) indicated that applying chicken manure did not affect the soil water content, however the higher percentage of soil water content achieved on applying chicken manure 20 t $h^{-1}$ (42.74 %), and the lower value of soil water content at without applying chicken manure (42.44 %). Applying chicken manure 20 t $h^{-1}$ showed 0.11 % soil water content higher than applying chicken manure 10 t $h^{-1}$, and 0.30 % when compared to without applying any organic fertilizer. The higher percentage of soil water content in a higher dose of chicken manure due to the high volume of organic fertilizer can improve the structure, texture, and porosity of the soil and subsequently, the balance between water and oxygen in the soil. Appropriate soil structure and texture can bind and provide water in the soil pore thereby reducing the temperature in the soil. Evaporation is one indication of the amount of water in the soil.




**Picture 1. Effect of chicken manure and Biochar on soil water Content (%)**

The appropriate quantity of chicken manure provides an opportunity for the microorganisms in the soil to establish the decomposition process faster, thus good physical, chemical, and biological soil conditions will improve the ability of the soil to bind water in the soil. The process of decomposition by microorganisms requires an appropriate temperature to be effectively decomposed. Stewart (1991), explained that water and temperature are primary factors in the process of decomposition of organic materials such as plant and animal residues which are directly related to microbial activity in the soil.

Picture 1 it shall be seen that applying of biochar affects the level of soil moisture, where the application of biochar of 10 t $h^{-1}$ has a different effect from without the application of biochar, but there is no detected significant difference with the application of biochar of 5 t $h^{-1}$. This is due to biochar being a soil improvement material where the process involves oxygen and converts biomass into a stable form of carbon that can be used to improve soil health and soil productivity. Evizal and Prasmatiwi (2023), reveal that biochar is high solid carbon produced from the pyrolysis of biomass such as wood, manure, and leaves under high temperatures and low oxygen conditions which is used for agricultural applications as a soil amendment.

The results in Table 1 show the effect of applying chicken manure on the number of leaves per plant at 4 and 6 weeks after planting. The application of chicken manure 20 t $h^{-1}$ had a different effect from the without the application of chicken manure, but there was no noticeable difference with the application of chicken manure 10 t $h^{-1}$ at the observation of 6 weeks after planting. Observation, 4 weeks after planting showed differences in influence between each treatment. The highest number of leaves in the second week of observation showed interaction (M2B0= 9.5833), week 4 (14.75), and week 6 (31.00). Conversely, the number of leaves was less in the second week amounting to 7.1667 in the combination of M2B2, week 4 (12.17), and week 6 (23.61). The application of the appropriate dose of chicken manure has a role in the growth of the vegetative part of the plant. These results are due to the optimal application of manure to create better physical, chemical, and biological soil conditions and subsequently absorption by roots, photosynthesis processes, and translocation to the vegetative parts of plants including the increase in the number of leaves. Gunawan, et. al. (2021) explained that optimal nutrition in the soil has a role in stimulating the growth of vegetative and reproductive parts of plants to provide maximum results. Bahri (2006), confirmed that the presence of organic fertilizers can affect the vegetative growth of plants, thus the final yield of plants could be achieved maximally (Husnihuda et al., 2017).

**Table 1. Effect of chicken manure and biochar on the number of leaves (sheet)**

| Treatments | week 2 | Treatments | week 4 | Growth Rates (GR) | week 6 |
|---|---|---|---|---|---|
| M0B0 | 7.1667c | M0 | 12.17c | 11.44 | 23.61b |
| M0B1 | 7.25c | M1 | 14.25b | 16.22 | 30.47a |
| M0B2 | 7.333c | M2 | 14.75a | 16.25 | 31a |
| M1B0 | 7.75bc | LSD | 0.4856 | | 0.9137 |
| M1B1 | 8.75ab | CV | 3.54 | | 3.22 |
| M1B2 | 8.25b | F pr | 0 | | 0 |
| M2B0 | 9.5833a | B0 | 13.64A | 14.89 | 28.53A |
| M2B1 | 8.3333b | B1 | 13.67A | 14.19 | 27.86A |
| M2B2 | 9ab | B2 | 13.86A | 14.83 | 28.69A |
| LSD: | 0.8634 | F pr | 0.5826 | | 0.1557 |
| CV: | 6.12 | | | | |
| F pr: | 0.0219 | | | | |

Justification: The letter followed by the same lowercase or uppercase does not show different effects at the LSD 5 %

Observations 2 weeks after planting showed that the combination of applying chicken manure 20 t $h^{-1}$ and without biochar was different in effect from applying chicken manure combined with biochar 10 t $h^{-1}$, 5 t $h^{-1}$, or without biochar, but there was no difference in effect with the combination of applying chicken manure 20 tons per hectare and biochar 10 t $h^{-1}$. The application of chicken manure and biochar in suitable soil environmental conditions can improve the physical, chemical, and biological conditions of the soil so that plant roots easily absorb nutrients for plants. Edduard et. al. (2020) explained that solid organic materials such as chicken residues and biochar provide a decrease in soil density and high organic C levels, which leads to better soil structure and subsequently plant roots are effortless to develop and optimize the absorption of nutrients and water in the soil.

Biochar application showed no significant effect on leaf count at all observation times. However, biochar with a dose of 10 t $h^{-1}$ gave the highest leaf count result of 28.69 no and the lowest 28.53 in treatment without biochar. Applying Biochar with the appropriate dose has the potential to improve soil conditions and plant productivity in the absorption of nutrients, water, and other minerals for further use for plant needs. The

role of biochar in revitalizing soil conditions is the effectiveness of fertilization so that biochar can bind nutrients in maximum conditions and release for the necessity of plant absorption (slow release), thus plants avoid nutrient poisoning (especially micronutrients). Other studies found that the biochar from rice husks could build soil and increase plant efficiency in utilizing nutrients for the development of plants (Dellah, 2023).

The interaction between chicken manure and biochar at plant height (table 2) showed the highest yield in the second week at 20t/h and without biochar (23.1667 cm), at weeks 4 and 6 at 20 t $h^{-1}$ and 10 t $h^{-1}$ (39.5 cm, and 51.5 cm) biochar.

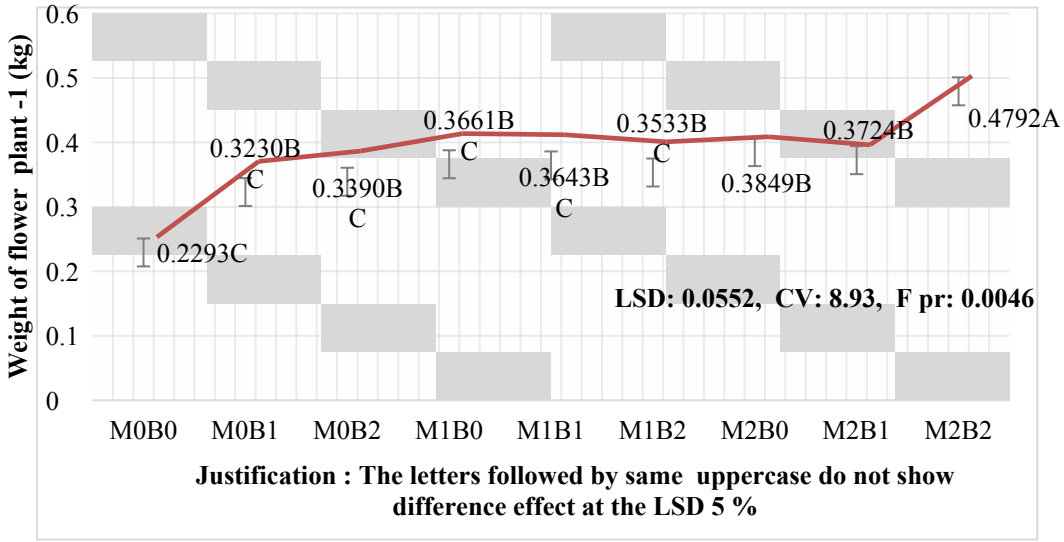
**Table 2. Effect of Chicken Manure and Biochar on Plant Height (cm)**

| Treatments | weeks 2 | GR 2-4 | weeks 4 | Growth Rates (GR) | weeks 6 |
|---|---|---|---|---|---|
| M0B0 | 15.1667c | 9.5833 | 24.75d | 17.75 | 42.5d |
| M0B1 | 13e | 9.25 | 22.25e | 18 | 40.25e |
| M0B2 | 13.25d | 9 | 22.25e | 17.25 | 39.5e |
| M1B0 | 21.25b | 12.75 | 34c | 11.833 | 45.8333c |
| M1B1 | 22.5ab | 13.25 | 35.75c | 14.42 | 50.1667ab |
| M1B2 | 21b | 13 | 34c | 15.08 | 49.0833b |
| M2B0 | 23.1667a | 14.17 | 37.3333b | 13.92 | 51.25ab |
| M2B1 | 21.5833b | 12.5 | 34.0833c | 13.42 | 47.5bc |
| M2B2 | 22.75ab | 16.75 | 39.5a | 12 | 51.5a |
| LSD: | 1.2172 | | 1.9524 | | 2.2321 |
| CV: | 3.64 | | 3.58 | | 2.78 |
| Fpr: | 0.0036 | | 0.0002 | | 0.0002 |

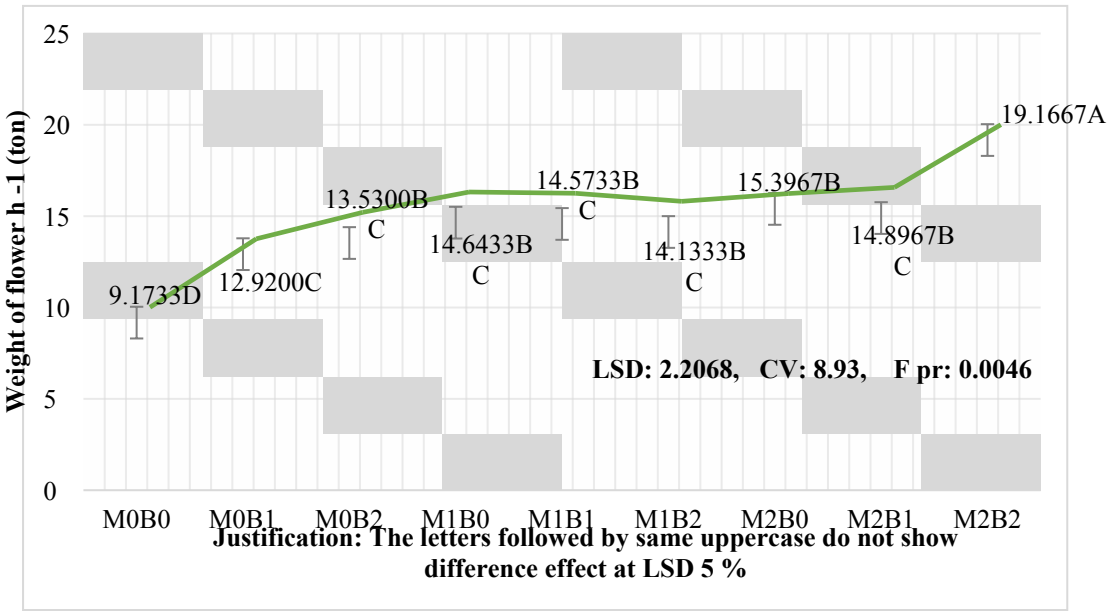
Justification: The letter followed by the same lowercase does not show a difference effect at the LSD 5 %

The rate of increase in plant height (2 mst-4mst) for the highest yield of chicken manure 20 t $h^{-1}$ and without biochar was 14.17 cm (61.16 %), while the growth rate of (4 wap– 6 wap) was 13.92 cm (37.29 %). The rate of increase in height for chicken manure 20 t $h^{-1}$ and biochar 10 t $h^{-1}$ was 16.75 cm (73.63%) and 12 cm (30.38%). These results showed that the rate of increase in plant height decreased after 4 weeks. This is due to in the vegetative growth phase, plants actively absorb nutrients for the formation and extension of vegetative organs, and in the phase of flowering, fruit, and seed formation, 80% of photosynthate results are translocated to fruits and seeds. The addition of chicken manure and biochar which is considered an organic material that can mobilize nutrients in the soil to form ion particles for effortless absorption (Edduard et al., 2022). Widowati, (2004) added that the use of chicken manure and biochar simultaneously with appropriate quantities affects the speed of nutrient absorption by plants.

The interaction between chicken manure fertilizer and biochar is seen in production per plant, where the combination of chicken manure 20 t $h^{-1}$ and biochar 10 t $h^{-1}$) provides a stronger effect than other combinations with a yield of 0.4792 kg. The combination of applying 20 t $h^{-1}$ chicken manure and without biochar achieved higher flower weight per plant (0.3849 kg) than 10 t $h^{-1}$ chicken manure combined with biochar 10 t $h^{-1}$ (0.3533 kg), 5 t $h^{-1}$ (0.3643 kg) and no biochar (0.3661 k). However, there is no significant difference between the application of chicken manure 20 t $h^{-1}$ and biochar 5 t $h^{-1}$ (0.3724 kg). The lowest yield was obtained without chicken manure and biochar (0.2293 kg). From these results, it is suspected that applying chicken manure and biochar in higher doses could improve soil properties and provide nutrients to increase flower production. Mayadewi (2007), said that the use of organic materials such as chicken manure fertilizer and optimal biochar is very important to improve soil quality and character such as increasing the ability of the soil to bind water so that soil temperature could be controlled, increasing the ability of the soil to absorb nutrients and water, thus the photosynthesis process be able to run well and the resulting photosynthesis is utilized by plant parts such as flowers, fruits, and seeds. Research by Amalia et al. (2019) and Isdarmanto (2009) that the addition of chicken manure 20 t $h^{-1}$ provides higher cauliflower flower production per hectare compared to the use of lower doses due to the content of essential macronutrients in chicken manure is sufficient for the necessity of cauliflower. Warnock et al. (2007) stated that biochar can optimize plant growth and yield, reducing nutrient loss due to leaching. Steiner et al. (2003), added that microbial activity in the soil increases with the addition of biochar in the soils, thereby increasing organic matter in the soil. Lehmann and Joseph (2009), revealed that the addition of biochar can increase the ability of soil to bind water, increase CEC, and provide essential nutrients to be absorbed by plants.




**Picture 2. Effect of chicken manure and biochar on weight of flower per plant (kg)**




**Picture 3. Effect of chicken manure and biochar on weight of flower per hectare (tone)**

The application of chicken manure 20 t $h^{-1}$ combined with biochar 10 t $h^{-1}$ with a yield of 19.1667-ton $h^{-1}$ is different from the effect of the combination of chicken manure fertilizer and other biochar on flower production per hectare (picture 3). The application of 20 t $h^{-1}$ chicken manure that is not accompanied by biochar gives better results (15.3967 tons) than the application of 20 t $h^{-1}$ chicken manure, 10 t $h^{-1}$ combined with 5 t $h^{-1}$ biochar and without biochar picture 3. The results mentioned above indicate that one of the roles of chicken manure and biochar which is organic matter is to be a proper habitat for the development of microorganisms. Chan et al., (2007) explained that the combination of organic materials such as chicken shrimp fertilizer and biochar which is used as a habitat for microorganisms can increase soil biological activities due to decreased competition between microorganisms in the soil. Increased activity of soil microorganisms causes an increase in the amount of nutrients in the soil which are further absorbed by plants for the needs of crop production, especially flowers, fruits, and seeds.

## IV. Conclusion

The result and discussion concluded that there was an interaction between chicken manure and biochar on plant height, flower weight per plant, and flower weight per hectare. The factors of chicken manure and biochar each significantly influence soil moisture content and leaves number. The highest flower production per hectare was obtained from a combination of chicken manure treatment doses of 20 t $h^{-1}$ and biochar of 10 t $h^{-1}$.

The lowest flower production per hectare was obtained from a combination of treatments without applying chicken manure and biochar (control).

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