# *Environmental Modification of Growing Cabbage Flower (Brassica oleracea. L). in Dryland with Organic Fertilizer and Watering Interval*

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***Abstract*—Cabbage (Brassica oleracea L.) is a vegetable plant from sub-tropical regions. The temperature range for the growth of cabbage is 15 - 24 oC with optimum humidity between 80-90%. The main obstacle in cultivating cabbage flowers in lowland dryland is the lack of water due to low rainfall. Water and soil conservation by setting watering intervals and giving organic matter can overcome those problems. The study aimed to modify the growing environment of cabbage plants by applying organic fertilizer and regulating the water supply. The research was carried out in May-August 2022 in the Greenhouse of the Faculty of Agriculture, Tadulako University. Soil and plant analysis was carried out at the Laboratory of Soil Science and Agronomy, Faculty of Agriculture, Tadulako University. Soil samples were taken from the Napu plains, Poso Regency, Central Sulawesi Province. The study used a two-factor Randomized Block Design. The first factor is the dose of chicken manure (A) which consists of 4 levels, namely: Control (A0), 10 tons ha-1 (A1), 15 tons ha-1 (A2, 20 tons ha-1 (A3). The watering interval (P) consists of 3 levels: 1 time a day (P1), a time in 2 days (P2) a time in 2 days (P3). The results showed that there was an interaction between chicken manure and watering intervals on plant height, number of leaves, fresh plant weight, plant dry weight, early flower emergence, fresh weight of shoots and dry weight of shoots, the highest fresh weight of shoots was 270,7 g***

***Keywords*—Organic Fertilizer, Watering Intervals***

## I. INTRODUCTION

Cabbage flower (*Brassica oleracea* L.) is a vegetable with excellent development potential due to its great economic and social worth. Vitamins A, B1, B2, C, and water are all present in cabbage flower along with protein, fat, calories, carbs, fiber, calcium, potassium, ash, phosphorus, iron, and sodium [1].

Cabbage flower is typically grown in the highlands, whereas it is still less common in the lowlands due to the relatively high temperature. By adjusting the growth environment and enhancing cultivation methods, cabbage flower can be developed in the lowlands.

Utilizing fertilization, which strives to maintain, improve, and sustain crop production and soil fertility, is one method of plant culture to increase plant growth and yield for the production of cabbage flower.

Fertilizer is a substance that is used to alter the physical, chemical, or biological characteristics of soil to make it better for plant growth. A substance that comprises one or more plant nutrients is referred to as fertilizer in this context.

N, P, and K contents are higher in chicken manure than in other types of manure [2], [3]. Because it can enhance the physical, chemical, and biological qualities of the soil, chicken dung has a lot of potential for usage [4].

The timing of watering intervals is another crucial part in controlling plant growth and production, in addition to fertilization. The maintenance of healthy plant growth requires ideal water conditions. Because it will disrupt plant metabolic systems, water stress can be damaging. To boost vegetable yields, water for plants is one factor that is crucial [5].

Plants that lack water will trigger the formation of abscisic acid-inhibiting hormones and growth-stimulating hormone inhibitors [6]. Research conducted on maize plants shows that water stress in the early phase of reproductive growth has the most significant effect on yield.

This study aimed to determine the effect of organic fertilizer application and water sprinkling intervals on the growth and yield of cabbage flower in the lowlands

## II. MATERIALS AND METHODS

### A. Study site and design

The research was conducted at the Greenhouse, Department of Agricultural Cultivation, Faculty of Agriculture, Tadulako University, Palu. Furthermore, took place from May 2022 to August 2022. Soil analysis was carried out at the Laboratory of Soil Science and Agronomy, Faculty of Agriculture, Tadulako University

The study used a two-factor Randomized Block Design (RBD). The first factor is the dose of chicken manure (A) which consists of 4 levels, namely: without chicken manure = control (A0), 10 tons of chicken manure


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ha$^{-1}$ equivalent to 21.3 g/polybag (A1), 15 tons of chicken manure ha$^{-1}$ is equivalent to 31.9 g/polybag (A2), chicken manure 20 tonnes ha$^{-1}$ is equivalent to 42.5 g/polybag (A3). The second factor is the water sprinkling interval (P) which consists of 3 levels: watering one time a day (P1), two days one time (P2) and three days one time (P3). Thus there were 12 treatment combinations, each repeated three times to obtain 36 experimental units.

B. Experimental steps

*a) Collection and preparation of soil samples*: Soil samples were taken from the plains of Napu, Poso Regency, Central Sulawesi Province, with a surface layer of soil with a depth of approximately 20 cm, then air-dried for one week in the preparation room in the laboratory. The air-dried soil samples were pounded to obtain a uniform soil aggregate size, then filtered and placed on the floor coated with plastic and mixed evenly to obtain a homogeneous soil sample.

*b) Preparation of manure*: Manure is obtained from fermented boiler manure. Before being applied, it is first analyzed to determine the levels of C-organic, N, P, and K.

*c) Preparation of planting media*; Air dry soil samples that passed a 2 mm diameter sieve were weighed as much as 8 kg/polybag. Then it is mixed evenly with chicken manure according to the treatment, then put in a polybag labelled according to the treatment code.

*d) Watering*; Each polybag was given water up to field capacity according to the treatment. Watering is done in the morning.

*e) Planting and maintenance*; Planting is carried out directly into polybags which have been given a mixture of soil and chicken manure according to the treatment dose. Three cabbage flower seeds were planted in each polybag with a depth of 0.2-1.0 cm. After three weeks, the growing seedlings were selected and uprooted so that one cabbage flower plant remained in each polybag. Maintenance includes watering and cleaning weeds that grow in polybags.

*e) Harvest*; Harvesting is done in the eighth week and is harvested in the morning so that there are no pens.

## III. RESULTS AND DISCUSSION

A. Results

*a) Chemical Composition of Chicken Manure*: The results of the analysis of the chemical composition of the chicken manure used contained C-organic 16.10%, Nitrogen (N) 2.44%, Phosphorus (P) 0.67%, Potassium (K) 1.24% and C/N of 6.59% (Table 1). This shows that chicken dung is classified as having high nutrient levels, so it can improve the soil's physical, chemical and biological properties, which in turn can increase soil fertility.

TABLE 1. CHEMICAL COMPOSITION OF FERMENTED CHICKEN MANURE

| Parameter | Value (%) |
|---|---|
| C Organic | 16,10 |
| Nitrogen (N) | 2,44 |
| Phosphor (P) | 0,67 |
| Kalium (K) | 1,24 |
| C/N | 6,59 |

Source: Soil Science Laboratory, Faculty of Agriculture, University of Tadulako

*b) Components of plant growth*: The average yield of plant height, number of leaves and flowering age of cabbage flower plants in chicken manure treatment and watering intervals are presented in Table 2.

The dose of chicken manure was 15 t ha$^{-1}$, and the interval of watering once a day resulted in the highest plant height of 27.8 cm and the highest number of leaves, namely 22.7 strands, different from the other treatments except for the treatment of giving chicken manure doses of 20 t ha$^{-1}$ and once a day watering interval.

TABLE 2. PLANT HEIGHT, NUMBER OF LEAVES, AND FLOWERING AGE OF FLOWERING CABBAGE PLANTS ON THE TREATMENT OF CHICKEN MANURE AND WATER WATERING INTERVAL

| Treatments | **Plant Height (cm)** | **Number of leaves** | **Flower age (day)** |
|---|---|---|---|
| Without fertilizer, watering once in 1 day | 18.8 bcd | 12.3 cde | 53.0 ab |
| Without fertilizer, watering oncein 2 days | 16.5d | 10.7 de | 56.0 ab |
| Without fertilizer, watering once in 3 days | 16.9 d | 9.0 e | 62.7 a |
| Chicken manure 10 t ha$^{-1}$, once in 1 day | 19.8 bcd | 16.3 bc | 45.0 bc |
| Chicken manure 10 t ha$^{-1}$, once in 2 days | 17.3 cd | 12.0 cde | 47.7 abc |
| Chicken manure 10 t ha$^{-1}$, watering once in 3 days | 17.1 d | 10.3 de | 51.0 abc |
| Chicken manure 15t ha$^{-1}$, watering once in 1 day | 27.8 a | 22.7 a | 36.0 c |
| Chicken manure 15 t ha$^{-1}$, watering once in 2 days | 19.3 bcd | 14.3 bcd | 46.3 abc |
| Chicken manure 15t ha$^{-1}$, watering once in 3 days | 18.6 bcd | 11.0 de | 49.6 abc |
| Chicken manure 20 t ha$^{-1}$, watering once in 1 day | 24.3 abc | 19.0 ab | 44.3 bc |
| Chicken manure 20 t ha$^{-1}$, watering once in 2 days | 19.4 bcd | 13.3 cde | 45.6 bc |
| Chicken manure 20 t ha$^{-1}$, watering once in 3 days | 17.8 bcd | 12.0 cde | 50.7 abc |

Note: the numbers followed by the same letter in the same column are not significantly different in the HSD test at the 5% level

The fastest flowering age of 36 days was obtained in the treatment of chicken manure doses of 15 t ha$^{-1}$, and the watering interval once a day was different from the treatment without chicken manure application with watering intervals once a day, once in two days and once in three days times but not different from other treatments.

*c) Components of crop yield*: Fresh weight of plants and fresh weight of heads of cabbage flower plants in chicken manure treatment and watering intervals are presented in Table 3.

TABLE 3. FRESH WEIGHT OF PLANT AND FRESH WEIGHT OF FLOWER CABBAGE HEADS IN THE TREATMENT OF CHICKEN MANURE AND WATER WATER INTERVAL

| Treatment | Plant fresh weight (g) | Cabbage fresh weight (g) |
|---|---|---|
| Without fertilizer, watering once in 1 day | 254.5 cd | 99.3 de |
| Without fertilizer, watering oncein 2 days | 229.9 cd | 63.4 e |

| | | |
|---|---|---|
| Without fertilizer, watering once in 3 days | 163.3 d | 62.1 e |
| Chicken manure 10 t ha$^{-1}$, once in 1 day | 373.6 bc | 182.9 bc |
| Chicken manure 10 t ha$^{-1}$, once in 2 days | 289.7 bc | 153.3 c |
| Chicken manure 10 t ha$^{-1}$, watering once in 3 days | 245.8 cd | 106.2 d |
| Chicken manure 15t ha$^{-1}$, watering once in 1 day | 525.8 a | 270.7 a |
| Chicken manure 15 t ha$^{-1}$, watering once in 2 days | 335.2 bc | 170.3 bc |
| Chicken manure 15t ha$^{-1}$, watering once in 3 days | 327.9 bc | 150.7 c |
| Chicken manure 20 t ha$^{-1}$, watering once in 1 day | 46.,6 a | 202.03 b |
| Chicken manure 20 t ha$^{-1}$, watering once in 2 days | 308.0 bc | 161.33 c |
| Chicken manure 20 t ha$^{-1}$, watering once in 3 days | 291.7 bc | 146.08 c |

Note: the numbers followed by the same letter in the same column are not significantly different in the HSD test at the 5% level

The results of the 5% HSD test showed that the administration of chicken manure doses of 15 t ha$^{-1}$ and the interval of watering once a day resulted in the highest plant fresh weight of 525.8 g, different from the other treatments except for the treatment of giving chicken manure doses of 20 t ha$^{-1}$ and once a day watering interval. The highest fresh weight of flower heads, namely 270.7 g, was obtained in the treatment of chicken manure doses of 15 t ha$^{-1}$, and the watering interval was once a day and different from other treatments.

B. Discussion

Plants have a growth period that will increase the size or weight of plants that cannot return to normal, such as plant height and the number of leaves. The growing period of the plants also increased the fresh weight of the plants' dry weight, the initial appearance of flowers and the fresh weight of the heads. The application of various doses of chicken manure and watering intervals provided an excellent response to the parameters of plant height, number of leaves, fresh plant weight, the initial appearance of flowers and fresh weight of flower heads of cabbage flower.

The analysis of chicken manure (Table 1) shows that the content of macronutrients, especially N, P and K, is high. These elements are essential nutrients for plant growth, especially during the phase of the formation of vegetative organs. The element nitrogen plays a role in the formation of leaf chlorophyll, a constituent of protein and carbohydrates in the process of photosynthesis; phosphorus plays a role in the development of young plant roots and the process of division of meristem cells, and potassium supports the metabolic processes of the plant body. Thus, increasing the process will increase plant height, the number of leaves and total plant dry weight.

The results showed that the treatment of chicken manure dose of 15 tons ha$^{-1}$ and the watering interval once a day resulted in the highest value of the growth component (Table 2) and the yield component (Table 3). According to [7], a plant will grow well and thrive if all the nutrients are in sufficient quantities and available to plants. [8] stated that chicken manure contains three times more nitrogen than other manure. This content can increase plants' vegetative growth, such as plant height and the number of leaves. This is in line with [9], [10] that chicken manure significantly affects growth parameters and cabbage flower yields compared to cow manure and goat manure. The difference in growth is caused by the amount of nutrient content given.

Giving doses of chicken manure and watering intervals, besides affecting growth, can also increase the yield component of cabbage flower. This can be seen in the increase in plant fresh weight of 525.8g and 270.7g of fresh crop weight (Table 3). Optimal increase in plant growth and yield components due to the fulfillment of nutrients with the addition of chicken manure given before planting, so that the elements in the manure are quickly available to plants because they have been decomposed, which results in plant growth, number of leaves, total fresh weight of plants and heads cabbage flower is higher. Optimal results on plants represent good growth during the vegetative period. [11], [12] stated that fertilization could provide a higher fresh-weight production of a plant. This is because the fertilizer given is sufficient compared to other treatments to increase the fresh weight of the plants and provide optimum water because if the plants have excess water, then plant growth and yield will not be good. If the water needs of cabbage flower plants are adequately met, it can increase the maximum growth and yield of cabbage flower plants

The response of plants to fertilizer application will increase when using the correct type of fertilizer, dosage, time and application method. [13] stated that the correct dose of organic fertilizer is needed to achieve maximum generative growth. The role of chicken manure is to increase the soil's organic matter content to improve the soil's physical properties, especially soil structure, to make it more friable, water holding capacity and soil porosity. Adding organic matter also affects the availability of nutrients N, P, and K, so optimal application of chicken manure will increase crop production [14].

Optimum water conditions must support the continuity of good plant growth. Water stress can be harmful because it will interfere with metabolic processes in the plant body. The provision of water under optimum conditions can inhibit plant growth so that the impact is hampered from entering the next vegetative phase.

The longer the period of giving water to plants, the more groundwater will affect the growth of plants as a whole. This is in line with the statement [15] that the optimal interval of water administration can increase the performance of hormones in the cell wall. These conditions spur sugar formation, which can enlarge the cells so that large vacuoles are formed. Vacuoles actively absorb large amounts of water due to water absorption. The presence of cell-stretching hormones also spurs cells to elongate, and the cell walls grow thicker and spurs the growth of new cells, which in turn accelerates the growth of stems, leaves and roots.

Lack or excess water in each growth phase will result in abnormal growth and decreased plant yields [16]. According to [17], excess water can cause damage to plant roots due to a lack of air in stagnant soil.

## IV. CONCLUSION

The results showed an interaction between the application of chicken manure and the interval of watering on plant height, number of leaves, fresh plant weight, plant dry weight, the initial appearance of flowers, fresh weight of heads and dry weight of heads. Treatment of chicken manure dose of 15 t $ha^{-1}$ and watering intervals once a day can increase the highest fresh weight of flower heads of cabbage flower, namely 270.7 g.

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## REFERENCES

[1] S. Park *et al.*, "Quantification of glucosinolates, anthocyanins, free amino acids, and vitamin C in inbred lines of cabbage (Brassica oleracea L.)," *Food Chem.*, vol. 145, pp. 77–85, Feb. 2014, doi: 10.1016/j.foodchem.2013.08.010.

[2] S. Indrayani, N. Nuriyanah, L. Nurjanah, H. Wibowo, and D. Priadi, "The Production of Compost from Organic Wastes using Bioactivators and Its Application to Celery (Apium graveolens L.) Plant," *J. Ilmu Lingkung.*, vol. 19, no. 2, pp. 479–484, Aug. 2021, doi: 10.14710/jil.19.2.479-484.

[3] L. T. Indriyati, "Chiken Manure Composts as Nitrogen Sources And Their Effect on the Growth And Quality of Komatsuna (Brassica rapa L.)," *J ISSAAS*, vol. 20, no. 1, pp. 52–63, 2014.

[4] O. Dikinya and N. Mufwanzala, "Chicken manure-enhanced soil fertility and productivity: Effects of application rates," *J. Soil Sci. Environ. Manag.*, vol. 1, no. 3, pp. 46–54, 2010.

[5] M. Gavrilescu, "Water, Soil, and Plants Interactions in a Threatened Environment," *Water*, vol. 13, no. 19, p. 2746, Oct. 2021, doi: 10.3390/w13192746.

[6] T. Coolong and J. C. Diaz-Perez, "Principles of Irrigation and Scheduling for Vegetable Crops in Georgia," *UGA Coop. Ext. Bull.*, vol. 151, p. 12, 2022.

[7] R. Wielemaker, O. Oenema, G. Zeeman, and J. Weijma, "Fertile cities: Nutrient management practices in urban agriculture," *Sci. Total Environ.*, vol. 668, pp. 1277–1288, Jun. 2019, doi: 10.1016/j.scitotenv.2019.02.424.

[8] F. M. Azmi, N. S. Tajudin, R. Shahari, and C. N. A. Che Amri, "Effects of different chicken manure rates of on early growth of fig (Ficus carica)," *Environ. Contam. Rev.*, vol. 2, no. 1, pp. 19–22, Oct. 2019, doi: 10.26480/ecr.01.2019.19.22.

[9] A. F. A. Setya, "Kajian penggunaan beberapa macam pupuk kandang terhadap pertumbuhan dan hasil tanaman bunga kol(Brassica oleraceea L.) pada jarak tanam yang berbeda," *J. Produksi Tanam.*, vol. 5, no. 6, pp. 939–946, 2017.

[10] O. Thepsilvisut, P. Chutimanukul, S. Sae-Tan, and H. Ehara, "Effect of chicken manure and chemical fertilizer on the yield and qualities of white mugwort at dissimilar harvesting times," *PLOS ONE*, vol. 17, no. 4, p. e0266190, Apr. 2022, doi: 10.1371/journal.pone.0266190.

[11] Y. Du, B. Cui, Q. zhang, Z. Wang, J. Sun, and W. Niu, "Effects of manure fertilizer on crop yield and soil properties in China: A meta-analysis," *CATENA*, vol. 193, p. 104617, Oct. 2020, doi: 10.1016/j.catena.2020.104617.

[12] F. Naz, "Plant nutrition, transport, mechanism and sensing in plants," in *Sustainable Plant Nutrition*, Elsevier, 2023, pp. 209–228. doi: 10.1016/B978-0-443-18675-2.00002-X.

[13] D. M. Williams, H. Blanco-Canqui, C. A. Francis, and T. D. Galusha, "Organic Farming and Soil Physical Properties: An Assessment after 40 Years," *Agron. J.*, vol. 109, no. 2, pp. 600–609, Mar. 2017, doi: 10.2134/agronj2016.06.0372.

[14] J. R. de S. Lima *et al.*, "Effects of Poultry Manure and Biochar on Acrisol Soil Properties and Yield of Common Bean. A Short-Term Field Experiment," *Agriculture*, vol. 11, no. 4, p. 290, Mar. 2021, doi: 10.3390/agriculture11040290.

[15] C. Wagg, S. Hann, Y. Kupriyanovich, and S. Li, "Timing of short period water stress determines potato plant growth, yield and tuber quality," *Agric. Water Manag.*, vol. 247, p. 106731, Mar. 2021, doi: 10.1016/j.agwat.2020.106731.

[16] F. Karandish and J. Šimůnek, "Two-dimensional modeling of nitrogen and water dynamics for various N-managed water-saving irrigation strategies using HYDRUS," *Agric. Water Manag.*, vol. 193, pp. 174–190, Nov. 2017, doi: 10.1016/j.agwat.2017.07.023.

[17] S. Paikaray and T. Mahajan, "Hydrogeochemical processes, mobilization controls, soil-water-plant-rock fractionation and origin of fluoride around a hot spring affected tropical monsoonal belt of eastern Odisha, India," *Appl. Geochem.*, p. 105521, Nov. 2022, doi: 10.1016/j.apgeochem.2022.105521.