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Media Growing Techniques and Different Soil Types to Increase Agronomic Characteristics and Content of Flavonoid Compounds on Dayak's Onion (Eleutherine palmifolia Merr.)

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ABSTRACT

Utilization of biodiversity in the form of medicinal plants is an alternative to maintain health. Dayak onions as efficacious medicinal plants, have the potential to be developed. The optimal benefits of Dayak onions can be obtained if the raw materials used are of high quality. Environmental factors greatly affect the quality and quantity of tubers, including cultivation techniques and soil types. This research aims to study various cultivation techniques and soil types to improve the agronomical characteristics and flavonoid content of Dayak Onion. The study used a factorial randomized block design,3 repetitions. Factor I was the type of soil (T1=peat soil; T2=sandy soil). Factor II was the type of cultivation technique B0=without fertilization; B1=organic fertilization (chicken manure 20 $t.ha^{-1}$); B2=inorganic fertilization (200 $kg.ha^{-1}$urea,150 $kg.ha^{-1}$ SP-36,200 $kg.ha^{-1}$ KCl); B3=combination of organic+inorganic fertilization. The results showed that the interaction treatment of various cultivation techniques and soil types had a significant effect on plant height, number of leaves, number of saplings. The combination of organic+inorganic fertilizers (chicken manure 20 $t.ha^{-1}$ and 200 $kg.ha^{-1}$ urea+150 $kg.ha^{-1}$ SP-36+200 $kg.ha^{-1}$ KCl) planted on peat soil types gives the best results on tuber wet weight 48.27 g/clump, dry tubers 16.73 g (12 wap) The average content of flavonoids planted on peat soil was higher 64.75 compared to sandy soil 52.33.

1. INTRODUCTION

Indonesia is a country with a high level of biodiversity. One form of biodiversity in the form of medicinal plants as a source of biopharmaceuticals whose use continues to increase [1]. Dayak Onion is a local resource-based biopharmaceutical plant that has habitat suitability in Kalimantan [2], empirically and clinically proven as an efficacious medicinal plant that has the potential to be developed. Dayak onion bulbs contain compounds: alkaloids, glycosides, flavonoids, steroids, phenolics, quinones, tannins, triterpenoids [3], natural antioxidants, and vitamin C. Dayak onion tubers are useful as antiviral, antifungal, and anti-cancer [4], inhibitors of leukemia cell proliferation, anti-diabetics [5], antihypertensive [6], preventing heart disease, anti-bleeding agent and as an immunostimulant to boost immunity [7].

Several studies have been conducted including flavonoid compounds in onions proven to stimulate the immune system by increasing the activity of macrophages and T lymphocytes [8], ethanol extract of Dayak onions has the ability as an immunomodulator by increase Ig M in mice [9], immunostimulant in increasing the diameter of the germinal center in the lymph nodes and increasing serum IgG levels [10], inhibiting the growth of *Staphyloccocus aureus* with a minimum inhibitory concentration of 1% with an inhibitory diameter of 14.49 ± 0.51 mm and Trichophyton rubrum with a minimum inhibitory concentration of 15% with an inhibitory diameter of 15.06 ± 0.42 mm [11], has strong antioxidant activity or an inhibitor against free radicals with an IC50 value of 25.3339 µg/ml [12]. In addition, giving Dayak onion bulb extract had an effect on reducing total and LDL cholesterol levels in *white male rats Wistar strain* [13]. The Borneo Dayak tribe, Indonesia, uses the tubers of this plant to fight heart disease and as an anti-inflammatory [14], increase breast milk production and for the treatment of stroke, breast cancer and the treatment of sexual disorders [15].

The optimal benefits of onion bulbs can be obtained if the raw materials used are of the high quality. The quality of tubers is determined through how much production and content of bioactive compounds of tubers by factors: 1) plant physiology, 2) genetics, 3) geography and 4) environment [16]. Environmental factors that affect them are cultivation techniques and the type of soil used for plant cultivation. The agricultural system implemented by Dayak farmers in Central Kalimantan varies greatly, both in their cultivation techniques and the type of soil used. Peat soil and sandy soil is a type of soil that has differences in terms of quality and characteristics.

Based on the description above, the variety of cultivation techniques and different soil types causes unknown cultivation techniques and soil types that can show optimal agronomic character as a raw material for quality medicinal plants. Therefore, there needs to be research on the engineering of growing media and different soil types to improve the agronomic character and flavonoid compound content of Dayak onions.

2. RESEARCH METHODS

2.1 Place and time

The research was conducted at a screen house, located in Petuk Katimpun Village, Central Kalimantan for ± 6 months. Soil and manure analysis is carried out in an integrated laboratory, at Palangka Raya University while the analysis of flavonoid compounds is carried out in the department of biochemistry and biomolecular, Faculty of Medicine, Universitas Lambung Mangkurat, Banjarmasin, South Kalimantan.

2.2 Materials and tools

Materials: onion bulbs obtained from farmers in Petuk Katimpun village, Palangka Raya city, Central Kalimantan, chicken manure organic fertilizers, inorganic fertilizers (Urea, SP-36, and KCl), dolomite, polybag 30 x 45 cm, peat soil taken from Kalampangan village, Sebangau District, Palangka Raya City, sandy soil taken from Petuk Katimpun village, Jekan raya District, Palangka Raya city, ethanol 70%, onion bulb powder, aquadest, $NaNO_2$ 5%, and $AlCl_3$ 20%. **Tools**: hoes, machetes, buckets, cameras, scales, filter paper, rotary evaporator, waterbath, test tube, *UV-Vis spectrophotometer*, 500 µ l micropipette and writing stationery.

2.3 Research methods

The study used a Factorial Random Group Design, 3 repetitions. The factor I consists of soil type (T_1=Peat soil, T_2=Sandy soil). Factor II consists of various cultivation techniques B_0=No fertilization, B_1=Organic fertilization (chicken manure doses of 20 t.ha^{-1}), B_2=Inorganic fertilization (200 kg.ha^{-1} urea+150 kg.ha^{-1} SP-36+200 kg.ha^{-1} KCl), and B_3=Organic + inorganic fertilization combination (chicken manure doses of 20 t.ha^{-1} + 200 kg.ha^{-1} urea+150 kg.ha^{-1} SP-36 + 200 kg.ha^{-1} KCl).

2.4 Research implementation

2.4.1 The implementation of research in the laboratory

Analysis of soil and chicken manure was carried out to determine soil fertility status and nutrient content. Soil analysis includes pH using potentiometer method, C-organic using Walkey-Black method, N-total using Kjeldahl macro method, P-available using P-Bray method, K, Ca_2^+, and Mg_2^+ using 1 M NH4Oac method. Analysis of flavonoid compound content is carried out by analytical procedures including 1) the manufacture of onion extract, 2) the determination of flavonoid levels including sample preparation and standard curve making, and 3) the determination of total flavonoids including:

a. Put the extract of onions that have been prepared into the test tube by adding 2 ml of aquadest
b. Add 150 µl and let stand for 6 minutes
c. Add 150 µl AlCl 10% and let stand 6 minutes
d. Add 2 ml of NaOH 4% dilute with aquadest until the tube volume reaches 5 ml and let stand 15 minutes
e. Absorbance is measured with a UV-Vis spectrophotometer at a wavelength of 520 nm
f. Performed 3 repetitions.

2.4.2 The implementation of research in the screen house

The planting media used is peat soil and sandy soil. In peat soil media: put 8 kg of soil into a 30 x 45 cm poly bag, then add 20 t.ha-^{1} organic chicken manure (130 g.polybag^{-1}) and 5 t.ha^{-1} dolomite (32 g. poly bag^{-1}). Sandy soil: 20 t.ha^{-1} organic chicken manure (100 g.polybag^{-1}) and 5 ton.ha^{-1} (25 g.polybag^{-1}) dolomite, except for the inorganic fertilizer treatment, chicken manure was not added. Organic fertilizer application is done 2 weeks before planting. While the application of inorganic fertilizers is given at a dose of 200 kg.ha^{-1} urea, 150 kg.ha^{-1} SP 36 and 200 kg.ha^{-1} KCl. Urea was given 2 times, ½ dose at planting and ½ dose at 30 days after planting. SP 36 and KCl fertilizers were applied at planting. Fertilizer combination of organic and inorganic fertilizers, namely organic chicken manure 20 t.ha^{-1} was applied 2 weeks before planting and inorganic fertilizers were applied at planting except for urea.

2.4.3 Variable measurements

Include Plant height (cm), Number of leaves, Number of saplings at the age of 6, 8, 10, and 12 wap, fresh weight of tubers, and dry weight of tubers (12 wap). The plant is harvested at an age of 12 wap (3 months) after planting. The data is analyzed with various analyses using the F 5% and 1% tests if there is a noticeable difference, followed by a medium value difference test using DMRT at the 5% level.

3. RESULTS AND DISCUSSION

3.1 Results of soil analysis and chicken manure fertilizer

Based on the results of soil analysis in Table 1 shows that the degree of acidity (pH) of sandy soil is lower than peat soil which is 4.7. Similarly, when viewed from the nutrient content of N-total, P-Bray, K-dd, Ca-dd, and Mg-dd contained in sandy soils are lower than in peat soils. The characteristics of sandy soils that are easily leached quickly with porosity which is very easy to seep water which transports nutrients deep into the soil resulting in nutrients not being reached by plant roots which is a constraint in cultivating plants [17]. While the characteristics of peat soil other than has a high level of acidity, high Cation Exchange Capacity (CEC) with low Base Saturation (BS) is a constraint in its cultivation. Differences in characteristics and nutrient content in 2 different types of soil will affect the growth rate and yield of cultivated Dayak onion plants.

Table 1. Results of soil analysis and chicken manure fertilizer

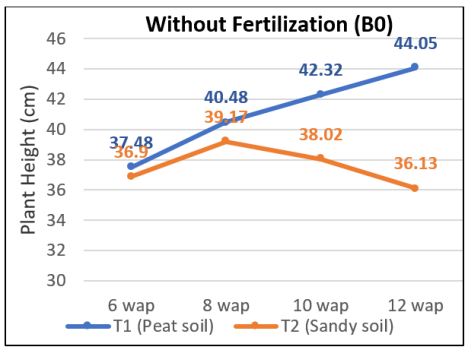
No.	Soil type	pH H_2O (1:2.5)	C-organic (%)	N-total (%)	P-Bray I (ppm)	K-dd (me/ 100 g)	Ca-dd (me/100 g)	Mg-dd (me/100 g)
1.	Peat soil	4.93	49.11	1.06	488.55	2.72	8.77	2.22
2.	Sandy soil	4.7	4.3	0.28	8.76	0.01	2.78	0.31
3.	Chicken manure	7.51	23.88	0.93	491.92	10.78	28.38	1.90

Description: Analysis in integrated Laboratory, Palangka Raya University

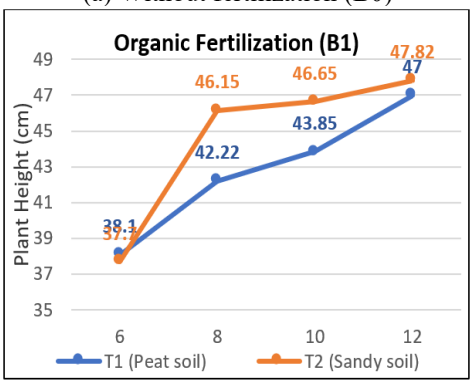
3.2 Agronomic character of plants

a. Plant height

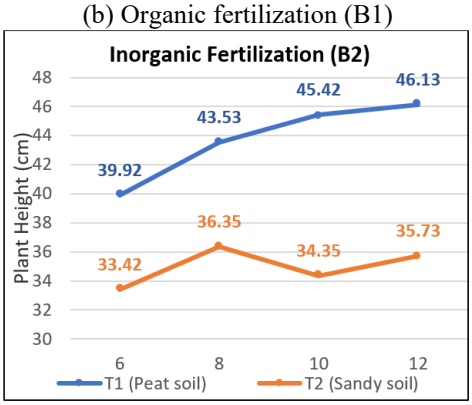
Based on the results of the various analysis and the test of the difference in the middle value to the height parameters of plants aged 6, 8, 10, and 12 wap obtained data as presented in the following graph:



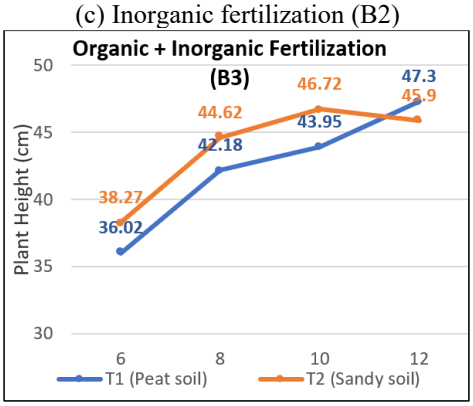
(a) Without fertilization (B0)



(b) Organic fertilization (B1)



(c) Inorganic fertilization (B2)



(d) Organic + inorganic fertilization

Figure 1. The high growth of plants on the treatment of various cultivation techniques and soil types differs in plants aged 6, 8, 10, and 12 wap

Based on the data presented in Figure 1 above, it can be seen that the use of a combination of chicken manure and inorganic fertilizer shows an increase in plant height at the age of 6, 8, 10, and 12 wap on peat soil types. This shows the positive response of plants due to the addition of fertilizer. Whereas in sandy soil types, plant height tends to decrease slightly in plants aged 12 wap, especially in the combination treatment of organic and inorganic fertilizers.

Improvement of the plant environment due to the provision of chicken manure fertilizer through the improvement of the physical, chemical, and biological properties of the soil will support the absorption of nutrients more optimally. Nutrients available in sufficient quantities will encourage the process of photosynthesis to be more active which results in the formation of higher proteins to support the high growth of plants. In line with Ghaffoor et al. [18] that manure exerts a good influence on the physical and chemical properties of the soil through the improvement of soil structure, sources of nutrients for plants [19] and increases soil microorganisms [20].

Similarly, the addition of inorganic fertilizers through the provision of NPK fertilizers can support a faster rate of growth and development. In line with Gardner et al. [21] that with the fulfillment of the nutritional needs of cultivated plants will tend to invest partly in early growth.

b. Number of leaves

Based on the results of the various analysis and the middle-value difference test to the parameters of the number of leaves of plants aged 8 and 10 wap obtained data as presented in Table 2 and Table 3 below:

Table 2. The effect of various cultivation techniques and soil types on the number of leaves aged 8 wap

Soil Type (T)	Fertilizer (B)			
	B0	B1	B2	B3
T1	5.50a	31.67d	16.50b	31.17c
	a	B	B	B
T2	6.00a	21.67b	9.83a	19.83b
	a	A	A	A

Description: The average value followed by the same letter in the same column or row means that it does not differ in effect according to dmrt 5%. B0=without fertilizer; B1=Chicken manure 20 $t.ha^{-1}$; B2=NPK (200 $kg.ha^{-1}$ urea, 150 $kg.ha^{-1}$ SP-36 and 200 $kg.ha^{-1}$ KCL; B3=Combination of Chicken manure +NPK; T1=Peat soil, T2=Sandy soil.

Table 3. The influence of various cultivation techniques and soil types on the number of leaves of plants aged 10 wap

Soil Type (T)	Fertilizer (B)			
	B0	B1	B2	B3
T1	7.33a	47.83c	26.50b	48.83c
	a	B	B	B
T2	8.67a	33.67b	14.00a	29.50b
	a	A	A	A

c. Number of tillers

Based on the results of the various analysis and the test of the difference in the middle value to the parameters of the number of tillers aged 12 wap presented in Figure 2 obtained data as presented in the following graph:

Based on data on the number of leaves of plants aged 8 and 10 wap and the number of plant saplings aged 12 wap shows that the treatment of organic fertilization (chicken manure fertilizer) provides growth in the number of leaves and the

number of saplings more than other treatments but does not differ markedly from the combination treatment of organic fertilizers + inorganic fertilizers grown on peat soil planting media. This is because organic fertilization treatment and a combination of organic + inorganic fertilization treatments both contribute nutrients, especially N nutrients that can support the vegetative growth of plants. Element N is an important ingredient in the constituents of amino acids, amides, nucleotides, and nucleoproteins but it is also essential for cell enlargement and division [21].

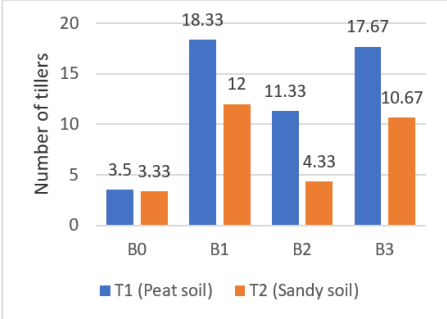


Figure 2. The number of saplings of the Dayak Onion plant in plants aged 12 wap on the treatment of such treatment technique cultivation and different types of soil

The use of chicken manure fertilizer has a positive effect in improving the structure and texture of peat soil so that water and nutrient need become more available to plants so that the growth process becomes improved. This can be seen in the growth in the number of leaves of 31.67 (8 wap) (Table 2) and 48.83 (10 wap) (Table 3). Likewise, the increase in the number of tillers was 18.33 (12 wap) in plants grown on peat soil types.

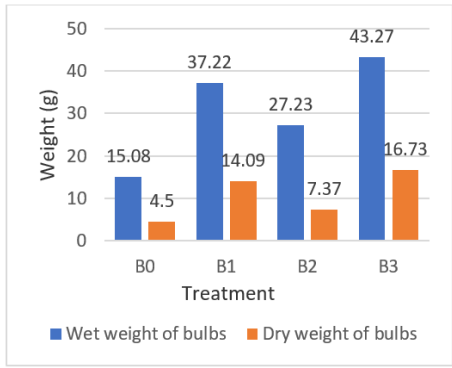
d. Fresh weight of tubers and dry weight of tubers

Based on the results of the analysis of variance and the test of the difference in middle values against the parameters of fresh weight of tubers and dry weight of plant tubers aged 12 wap (harvest) obtained data as presented in the following figure/graph.

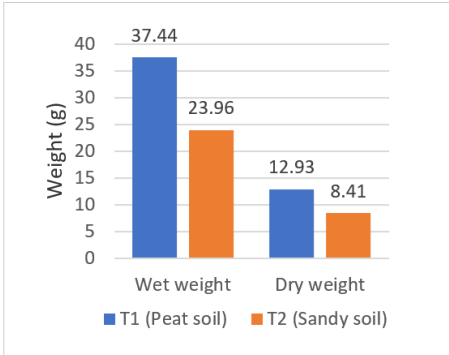
Data on the wet weight of tubers and dry weight of tubers in Figure 3 shows that the fertilization treatment of organic + inorganic fertilizer combinations show the highest wet weight and dry weight of tubers on peat soil planting media. This is because the combination of organic + inorganic fertilizers is at a balanced dose in providing nutrients needed by Dayak onion plants. Balanced fertilizer delivery is the basis for producing more optimal crop output, where the nutrient content can meet the requirements of plant physiology to get the expected results [22].

The benefits of chicken manure fertilizer in addition to improving the physical, chemical, and biological properties of the soil are also able to prevent Fe and Al poisoning in peat soils that react sourly. In addition, manure is also able to increase the availability of phosphates and humus levels which in the end can increase the Cation Exchange Capacity [23]. Similarly, the provision of inorganic fertilizers in the form of urea, SP-36, and KCl in balanced amounts greatly affects the growth and yield of tubers. Element N in urea fertilizer is an important ingredient as a constituent of amino acids, amides, nucleotides, nucleoproteins, and essential elements in cell division and enlargement [21].

Element N (Nitrogen) is needed by plants, especially in the vegetative phase for the formation of leaves and stems. The high availability of element N will form more chlorophyll so that the absorption of sunlight is more optimal which ultimately increases the rate of photosynthesis of plants. Element P (Phosphorus) plays a role in increasing carbohydrates, lengthening the roots, and increasing the number and size of tubers so that plant yields increase [24]. While element K (Potassium) plays a role in the process of photosynthesis where organic compounds are transported to the tubers and tubers produced more quality [25].



(a) Treatment cultivation technique



(b) Treatment different types of soil

Figure 3. Wet weight and dry weight of the bulbs of the Dayak onion plant at the age of 12 wap on the treatment of such treatment cultivation technique and different types of soil

Figure 4. The agronomic character of Dayak onion plants aged 12 wap on treatment such as cultivation technique and different types of soil

Based on Figure 4, it can be concluded that the addition of chicken manure fertilizer in this study can improve the physical, chemical, and biological properties of the soil, and the addition of N, P, and K fertilizers can create better plant environmental conditions so that the nutrients needed by

plants become more available in supporting agronomic character, namely growth and the formation of the yield of tubers. Increased vegetative growth due to the combination of organic + inorganic fertilization such as plant height, leaf count, and the number of saplings causes increased biomass formation which ultimately results in fresh weight and higher dry weight of plants [26].

3.3 Content of compound bioactive Dayak onion

a. Extraction results of Dayak onion bulbs

Table 4. The results of the extraction of onion bulbs in plants aged 12 wap due to the influence of treatment of various cultivation techniques and different soil types

Sample	Simplisia Powder Weight (g)	Condensed Extract Weight (g)	Randemen Value (%)
T1B0	15.0	1.1877	7.92
T1B1	15.0	1.0687	7.12
T1B2	15.0	1.4379	9.59
T1B3	15.0	1.6992	11.33
T2B0	15.0	1.7407	11.60
T2B1	15.0	1.6876	11.25
T2B2	15.0	1.0664	7.11
T2B3	15.0	1.4743	9.83

Description: B0=without fertilizer; B1=Chicken manure 20 $t.ha^{-1}$; B2=NPK (200 $kg.ha^{-1}$ urea, 150 $kg.ha^{-1}$ SP-36 and 200 $kg.ha^{-1}$ KCL; B3=Combination of Chicken manure +NPK; T1=Peat soil, T2=Sandy soil.

b. Test results of average flavonoid levels

Table 5. The results of the test of flavonoid compound content in the onion nut plant 12 wap due to the influence of treatment of various cultivation techniques and different types of soil

Treatment	Flavonoid content
T1B0	64.75d
T1B1	50.75c
T1B2	31.42a
T1B3	52.92c
T2B0	52.33c
T2B1	44.92b
T2B2	48.58bc
T2B3	49bc

Description: B0=The mean value followed by the same letter means that the effect is not significantly different according to the 5% DMRT. B0=without fertilizer; B1=Chicken manure 20 $^{t.ha-1}$; B2=NPK (200 $kg.ha^{-1}$ urea, 150 $kg.ha^{-1}$ SP-36 and 200 $kg.ha^{-1}$ KCL; B3=Combination of Chicken manure +NPK; T1=Peat soil, T2=Sandy soil.

Based on Table 4, it shows that the test results of the extraction of onion bulbs in the highest Dayak onion bulbs were in the treatment of plants grown on peat soil types with no fertilization treatment, which for the average flavonoid level was equal to 64.75 (Table 5) and the effect was significantly different from other treatments. Then followed by the treatment of organic + inorganic fertilization of 52.92 and fertilization with organic fertilizers of 50.75.

The above data shows that the difference in soil characteristics between peat soils and sandy soils also determines the content of flavonoid compounds in onion bulbs at the age of 12 wap. This shows that plant environmental factors also affect the synthesis of plant bioactive compounds in addition to heredity factors (genetic components) and ontogeny factors (developmental stages) [27].

Characteristics of sour peat soil media with higher nutrients (Table 1) in this study, it was not only able to improve the agronomic character of onion plants (growth and yield) but also able to stimulate the formation of flavonoid compounds that are higher than other treatments. This phenomenon proves that the same type of plant but planted at different locations or types of soil will produce secondary metabolic content that is not necessarily the same so this will affect its therapeutic effect. This study concluded that the characteristics of the soil with the nutrient content that is not necessarily the same between different soil types is one of the environmental factors that affect the growth, yield and content of bioactive compounds of the Dayak onion plant [28].

4. CONCLUSION

Media engineering grows in onion plants using fertilization techniques combination of organic + inorganic fertilizers with a dose of chicken manure fertilizer 20 $t.ha^{-1}$ + NPK (200 kg,ha^{-1} urea + 150 $kg.ha^{-1}$ SP-36 and 200 $kg.ha^{-1}$ KCl) planted on peat soil type gives the best influence on the wet weight of tubers, which is 48.27 g per clump and the dry weight of tubers is 16.73 g per clump. While the average flavonoid content planted in peat soils is higher by 64.75 compared to sandy soils by 52.333.

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