

Growth And Results Of Dayak Onion (*Eleutherine americana* Merr.) At Various Dosage Cow Manure Fertilizer And Kcl Fertilizer

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GROWTH AND RESULTS OF DAYAK ONION (*ELEUTHERINEAMERICANAMERR.*) AT VARIOUS DOSAGE COW MANURE FERTILIZER AND KCL FERTILIZER

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ABSTRACT

Development in the cultivation of Dayak plants needs to be developed so that each Dayak plant can grow and produce optimally. The addition of nutrients to the arrangement of Dayak onion plants help the plants to get maximum results. This study aims to determine: (1) the interaction between cow manure fertilizer and KCl fertilizer on growth and yield, (2) the dose of cow manure fertilizer that can provide the best growth and yield, and (3) the dose of KCl fertilizer that can provide growth and yield. the best yield on Dayak onion (*Eleutherineamericana*).

The research was conducted from March to 2020 in the Bukit Pinang Suryanata housing complex, Samarinda, Indonesia. The experiment used a 3 x 4 factorial arranged in a Randomized Completely Block Design with five replications. The first factor is the provision of cow manure consisting of 0, 20, and 40 Mg.ha⁻¹ fertilizer while the second factor is the KCl fertilizer dose consists of 0, 100, 200, and 300 kg.ha⁻¹. The data obtained is analyzed using analysis of variance if the significant effect was to compare the two treatment averages using the Least Significant Difference test at the 5% level.

The results showed the interaction between the treatment cow manure and KCl fertilizer on the variable number of plants aged 2 and 4 weeks after planting. The application of cow manure fertilizer has a significant effect on plant height, number of leaves, wet weight, number of tubers, dry weight. The application of KCl fertilizer showed a significant effect on the variable number of leaves at 2 weeks after planting. Cow manure fertilizer 40 Mg.ha⁻¹ and KCl fertilizer 300 kg.ha⁻¹ provide the best growth for Dayakonions plants.

KEYWORDS

Dayak Onions, Cow Manure, KCl Fertilizer.

I. INTRODUCTION

Indonesia with its biodiversity has various types of plants that are used as medicine. These medicinal plants are widely used traditionally by the community [1]. One of the medicinal plants that grows in Indonesia is Dayak onion (*Eleutherineamericana*Merr.). Dayak onion bulb is used as a breast cancer drug by the local people of Kalimantan, besides that it can also be used to treat heart disease, increase endurance, as an anti-inflammatory, anti-tumor and can stop bleeding [2]. The many benefits in treating this plant disease have chemical content, namely flavonoids, alkaloids, steroids and terpenoids with these ingredients that can be used as an alternative for human life. It is suspected that secondary metabolites such as glycosides, alkaloids and flavonoids can reduce blood sugar levels for patients with diabetes, as well as alkaloids which are well known as antimicrobials [3].

The development of Dayak onion production is currently still minimally carried out by the community, even though the prospect of Dayak onion to be developed into a modern medicinal plant is quite large for household scale and industrial scale because this plant can grow and adapt in all climates and soil types with a relatively short harvest time. 3-4 months) [4]. Lack of public knowledge of information about Dayak onion cultivation techniques is an inhibiting factor for the development of Dayak onion production at this time, while some parties cultivate it but it is still not optimal because the standard operating procedure (SOP) for Dayak onion cultivation does not yet exist [5].

The provision of superior seeds that produce plants with good quality is one of the factors supporting the success of the development of Dayak onions, therefore it is necessary to conduct research on development and innovation in the cultivation of Dayak onions so that these plants can grow and produce optimally and can produce a package. cultivation of plants that can be applied in the field. The Dayak onion plant itself does not have production data and has not received more attention from the government for the development process of its cultivation, but seeing the potential of Dayak onion as a multifunctional medicinal plant is very large, so it is necessary to improve the quality of growth and yield of the Dayak onion plant [3, 6].

Dayak onion plants in their growth require food substances or nutrients consisting of macro nutrients, such as: N, P, K, S, Mg, Ca and micro nutrients, such as: Fe, Mn, Zn, Cu, B, Mo [7]. Fertilization is one of the actions in increasing the nutrients in the soil, either directly or indirectly, so that the availability of nutrients for Dayak onion plants is well fulfilled [8]. Fertilizer itself is divided into two types, namely organic fertilizer and inorganic fertilizer.

Organic fertilizers that are widely used by farmers are animal manure because they are cheap and easy to obtain. Livestock whose feces are widely used include chickens, goats, cows, horses, and pigs, the manure used is usually in the form of solid or liquid manure which is used separately or simultaneously [9].

The most widely used organic fertilizer is cow manure, because in addition to being easy to get, cow manure has a nutrient content of 0.40% nitrogen, 0.20% phosphorus, 0.10% potassium and 85% water content [10]. The nutrient content in cow manure fertilizer still cannot meet the nutrients needed by Dayak onion plants, especially the K element which is the lowest available in cow manure fertilizer, which is only 10%, therefore it is necessary to add inorganic fertilizers that help meet the nutrient needs because in the process of improving the quality of tubers in Dayak onion plants, K nutrients are needed [11]. The application of inorganic fertilizers into the soil can increase the availability of nutrients quickly for plants because of their high nutrient content and quickly available [7]. Generally, fertilizers containing potassium nutrients that are often used are KCl fertilizers.

II. RESEARCH METHODS

The research was conducted from March to July 2020, in the Bukit Pinang residential area, SuryanataSamarinda.

The materials used are Dayak onion bulbs, KCl fertilizer, Urea fertilizer, SP-36 fertilizer, cow manure fertilizer, soil and liquid organic pesticides. The tools used are polybags measuring 40 cm x 40 cm, oven, calculator, camera, label paper, tape measure, hoe, machete, scissors, analytical scale, aluminum foil, raffia rope, stationery and bucket.

The study used a Randomized Block Design (RAK) with 3 x 4 factorial analysis, each treatment was repeated 5 times and the grouping was based on the weight of the tubers used. The first factor is the dose of cow

manure fertilizer (P) consisting of three levels, namely: p_1 =without cow manure, p_2 = 20 Mg ha⁻¹ (250 g polybag⁻¹) and p_3 = 40 Mg ha⁻¹ (500 g polybag⁻¹). The second factor is the dose of KCl (K) fertilizer consisting of four levels, namely: k_0 = without KCl fertilizer, k_1 = 100 kg.ha⁻¹ (1.25 g polybag⁻¹), k_2 = 200 kg.ha⁻¹ (2.5 g polybag⁻¹) and k_3 = 300 kg.ha⁻¹ (3.75 g polybag⁻¹).

Activities carried out in this study include: tuber selection, land preparation for polybag layout arrangement, preparation of planting media, planting, application of KCl fertilizer doses, maintenance (watering, weeding, replanting and weeding) and harvesting. Data collection included plant height and number of leaves aged 2, 4, 6, 8, 10, 12 weeks after planting, canopy fresh weight, root fresh weight, tuber fresh weight, total plant fresh weight per clump, number of tubers per clump, dry weight which consisted of shoot dry weight, root dry weight, tuber dry weight and total plant dry weight per clump.

The research data were analyzed by means of variance, if there was a significant difference, to compare the two treatment averages followed by the Least Significant Difference Test (BNT) at the 5% level.

III. RESULTS AND DISCUSSION

3.1. Results

The results of research on growth and yield of Dayak onions at various doses of cow manure and KCl fertilizers and their interactions are presented in Tables 1 and 2 below.

Table 1. Recapitulation of Research Results High and Amount of Dayak Shallots (*Eleutherina Americana* Merr.) at Various Doses of Cow Manure and KCl Fertilizer

COW MANURE FERTILIZER	PLANT HEIGHT (cm) Age						NUMBER OF LEAVES (pieces) Age					
	5 2 MST	4 MST	6 MST	8 MST	10 MST	12 MS T	2 MST	4 MST	6 MST	8 MST	10 MST	12 MST
p_1 (0 Mg ha ⁻¹)	11,83 a	24,25	26,84	33,01 a	35,63 ab	36,62	1,55	3,30	9,05 a	13,00 a	17,55 a	20,30 a
p_2 (20 Mg ha ⁻¹)	15,57 c	24,46	28,10	32,98 a	34,39 a	35,44	1,70	3,35	11,85 b	16,70 b	19,55 a	22,55 a
p_3 (40 Mg ha ⁻¹)	13,66 b	24,70	27,99	36,32 b	38,19 b	38,55	1,75	3,90	13,60 b	19,90 c	24,45 b	28,20 b
BNT 5%	1,76	tn	tn	2,85	2,83	tn	tn	tn	2,11	3,15	4,17	4,46
KCL FERTILIZER	PLANT HEIGHT (cm)						NUMBER OF LEAVES (pieces)					
	5 2 MST	4 MST	6 MST	8 MST	10 MST	12 MS T	2 MST	4 MST	6 MST	8 MST	10 MST	12 MST
k_0 (0 kg ha ⁻¹)	13,01	23,91	27,41	33,75	35,76	36,31	1,80 b	3,47	11,40	15,53	18,93	21,93
k_1 (100 kg ha ⁻¹)	14,26	25,25	29,02	35,12	37,06	38,21	1,40 a	3,33	11,20	15,93	19,33	22,80
k_2 (200 kg ha ⁻¹)	13,74	24,05	26,40	33,09	34,49	35,67	1,87 b	4,07	11,60	16,87	20,60	23,60
k_3 (300 kg ha ⁻¹)	13,73	24,65	27,73	34,45	36,95	37,29	1,60 ab	3,20	11,80	17,80	23,20	26,40
BNT 5%	tn	tn	tn	tn	tn	tn	0,30	tn	tn	tn	tn	tn
INTER-ACTION	PLANT HEIGHT (cm)						NUMBER OF LEAVES (pieces)					
	5 2 MST	4 MST	6 MST	8 MST	10 MST	12 MS T	2 MST	4 MST	6 MST	8 MST	10 MST	12 MST

	T											
p _{k0}	10,76	22,96	24,90	30,10	33,18	32,9 8	2,20 Cb	4,40 Bb	10,60	14,80	19,00	21,60
p _{k1}	12,06	24,06	27,40	33,28	36,28	38,0 2	1,40 ABab	3,60 Ba	8,80	12,80	16,20	19,00
p _{k2}	12,02	24,16	26,26	34,56	35,66	37,5 8	1,60 Ba	3,20 ABa	9,00	12,40	16,00	18,40
p _{k3}	12,46	25,82	28,78	34,08	37,40	37,9 0	1,00 Aa	2,00 Aa	7,80	12,00	19,00	22,20
p _{k0}	16,22	24,70	28,66	34,18	35,28	36,4 8	1,80 Aab	3,40 ABab	11,60	14,00	15,40	18,20
p _{k1}	15,78	24,12	28,54	33,80	34,96	36,2 2	1,80 Ab	3,40 ABa	11,80	17,00	19,20	20,40
p _{k2}	15,60	25,20	27,26	31,86	32,84	33,8 4	1,80 Aab	4,00 Bab	12,60	19,20	23,20	26,60
p _{k3}	14,68	23,80	27,94	32,06	34,46	35,2 2	1,40 Aa	2,60 Aab	11,40	16,60	20,40	25,00
p _{k0}	12,04	24,08	28,66	36,96	38,82	39,4 6	1,40 Aa	2,60 Aa	12,00	17,80	22,40	26,00
p _{k1}	14,94	27,56	31,12	38,28	39,94	40,4 0	1,00 Aa	3,00 Aa	13,00	18,00	22,60	29,00
p _{k2}	13,60	22,80	25,68	32,84	34,98	35,5 8	2,20 Bb	5,00 Bb	13,20	19,00	22,60	25,80
p _{k3}	14,06	24,34	26,48	37,20	39,00	38,7 4	2,40 Bb	5,00 Bc	16,20	24,80	30,20	32,00
⁹ BNT 5%	tn	tn	tn	tn	tn	tn	0,53	1,30	tn	tn	tn	tn

¹¹ Explanation : The average number followed by the same letter in the same column shows no significant difference at 5% level of BNT

Table 2. Recapitulation of Research Results Wet Weight, Number of Bulbs and Dry Weight of Dayak Onion (*Eleutherine Americana*Merr.) at Various Doses of Cow Manure and KCl Fertilizer

COW MANURE FERTILIZER	BB TAJUK (g)	BB AKAR (g)	BB UMBI (g)	TOTAL BB (g)	TOTAL TUBER (g)	BK SHOOT (g)	BK ROOT (g)	BK TUBER (g)	TOTAL BK (g)
p ₁ (0 Mg ha ⁻¹)	17,98 a	4,18	17,88 a	40,04 a	7,85 a	3,46 a	0,56	5,17 a	9,19 a
p ₂ (20 Mg ha ⁻¹)	18,20 a	4,03	18,61 a	40,84 a	8,35 a	3,41 a	0,59	5,32 a	9,32 a
p ₃ (40 Mg ha ⁻¹)	22,92 b	5,04	23,06 b	51,02 b	10,80 b	4,38 b	0,68	6,64 b	11,70 b
BNT 5%	3,38	tn	3,65	7,6	1,6	0,66	tn	0,94	1,62
KCL FERTILIZER	BB TAJUK (g)	BB AKAR (g)	BB UMBI (g)	TOTAL BB (g)	TOTAL TUBER (g)	BK SHOOT (g)	BK ROOT (g)	BK TUBER (g)	TOTAL BK (g)
k ₀ (0 kg ha ⁻¹)	18,95	3,94	18,62	41,51	8,47	3,56	0,58	5,23	9,37
k ₁ (100 kg ha ⁻¹)	19,14	4,24	19,39	42,77	8,13	3,66	0,58	5,70	9,94
k ₂ (200 kg ha ⁻¹)	19,07	4,35	20,15	43,58	9,33	3,70	0,59	5,72	10,02

GROWTH AND RESULTS OF DAYAK ONION (*E. leutherineamericana* Merr.) AT VARIOUS DOSAGE COW MANURE FERTILIZER AND KCl FERTILIZER

	k ₃ (300 kg ha ⁻¹)	21,63	5,14	21,21	48,00	10,07	4,08	0,69	6,18	10,96
	18 BNT 5%	tn	tn	tn	tn	tn	tn	tn	tn	tn
INTERACTION	BB TAJUK (g)	BB AKAR (g)	BB UMBI (g)	TOTAL BB (g)	TOTAL TUBER (g)	BK SHOOT(g)	BK ROOT(g)	BK TUBER (g)	TOTAL BK (g)	
p ₁ k ₀	17.78	4.27	17.46	39.51	7.80	3.47	0.60	5.11	9.19	
p ₁ k ₁	18.33	4.24	17.98	40.55	7.40	3.43	0.54	5.34	9.31	
p ₁ k ₂	16.42	3.42	17.37	37.21	8.00	3.22	0.48	4.95	8.65	
p ₁ k ₃	19.39	4.80	18.69	42.88	8.20	3.71	0.62	5.28	9.61	
p ₂ k ₀	16.66	3.24	16.14	36.04	7.40	3.15	0.49	4.52	8.16	
p ₂ k ₁	16.18	3.66	17.24	37.08	7.40	3.31	0.59	5.20	9.09	
p ₂ k ₂	19.19	4.38	20.87	44.44	9.80	3.52	0.60	5.62	9.74	
p ₂ k ₃	20.78	4.85	20.17	45.79	8.80	3.66	0.69	5.94	10.30	
p ₃ k ₀	22.41	4.32	22.26	48.99	10.20	4.05	0.64	6.06	10.75	
p ₃ k ₁	22.91	4.83	22.96	50.69	9.60	4.24	0.60	6.57	11.41	
p ₃ k ₂	21.61	5.25	22.22	49.08	10.20	4.36	0.69	6.60	11.66	
p ₃ k ₃	24.73	5.77	24.78	55.33	13.20	4.88	0.77	7.31	12.96	
	18 BNT 5%	tn	tn	tn	tn	tn	tn	tn	tn	

Explanation : The average number followed by the same letter in the same column shows no significant difference at 5% level of BNT.

Ket : BB = Fresh weight

BK = Dry weight

3.2. Discussion

3.2.1. Interaction of Cow Manure Fertilizer and KCl Fertilizer Dosage

The results of variance showed that the interaction of the two treatments of cow manure fertilizer dose (P) and KCl fertilizer dose (K) had no significant effect on the variables of plant height, wet weight, dry weight and number of tubers of Dayakonion plants. However, it had a very significant effect on the number of leaves when the plants were 2 and 4 WAP. Overall interaction of cow manure fertilizer (P) and KCl fertilizer dose (K) showed the best growth on cow manure fertilizer treatment of 40 Mg.ha⁻¹ and KCl 300kg.ha⁻¹ (p₃k₃).

In general, the highest plants were produced in the p₃k₁ combination, which was 40.40 cm and the lowest was in the p₁k₀ treatment, which was 32.98 cm. This study showed that there was an increase in total plant height every week from 2 to 10 weeks after planting (MST). However, at the age of 12 WAP, the plant height growth rate began to stagnate.

In the parameter, the highest number of leaves, namely 32.22 leaves, was produced in the p₃k₃ combination and the lowest was 18.20 leaves in the p₂k₀ combination.

In the total parameter of the total wet weight of the plant, it showed that the highest total wet weight was produced in the p₃k₃ combination which was 55.33 g and the lowest was produced in the p₂k₀ combination, which was 36.04 g. Meanwhile, the total dry weight parameter of plants showed that the highest total dry weight was produced in the p₃k₃ combination, which was 12.96 g, while the lowest was in the p₂k₀ combination, which was 8.16 g. Although there was no significant difference in the total wet weight and dry weight variables of Dayak onion plants, the combination of various doses of cow manure (P) and KCl (K) fertilizers showed an increase in total wet weight and total dry weight of Dayak onion plants at each increase in fertilizer dose which are given.

The results of the variance showed that there was no interaction between the dose of cow manure fertilizer (P) and the dose of KCl (K) fertilizer on the number of Dayak onion bulbs. The results showed that the p₃k₃ combination produced the highest number of tubers, namely 13.20 bulbs per clump, while the lowest combination was p₁k₁, p₂k₀, and p₂k₁ which was 7.40 bulbs per clump. This is presumably because there are several dead tubers or tillers which can also affect the growth quality of the plant crown and roots of the Dayak onion plant. The death of some tubers was thought to be due to high rainfall during the time the research was conducted, causing the plants to have excess water and excess water in the Dayak onion plant could also cause a decrease in the quality of the tubers and could wash the available nutrients for plant needs. The results of research conducted by Haryati and Amelia showed that Dayak onions do not require a lot of water, because if it is in excess, it can affect the weight and quality of tubers per plant [14].

3.2.2. Cow Manure (P)

The results of variance showed that the dose of cow manure fertilizer (P) had a very significant effect on plant height variables when the plants were 2, 8 and 10 WAP, the number of leaves when the plants were 6, 8, 10 and 12 WAP, total wet weight, total weight dry weight and number of bulbs of Dayak onion, but had no significant effect on plant height at 4, 6 and 12 WAP, number of leaves at 2 and 4 WAP and wet weight and dry weight of roots. In the root weight variable, the results were not significantly different, this was presumably because some plant roots were dead and rotten, rotten roots would have an effect and could disrupt the growth of the Dayak onion plant because the roots functioned to support the establishment of the plant and absorb water and nutrients from the ground [15]. The death of plant roots is thought to be due to moist soil due to high rainfall. Overall treatment of various doses of cow manure fertilizer resulted in better growth of Dayak onion compared to treatment without cow manure fertilizer, treatment of 40 Mg.ha⁻¹ (p₃) resulted in the best growth of Dayak onion. This is because cow manure fertilizer can improve the physical, chemical and biological properties of the soil as well as increase the availability of both macro and micro nutrients which are needed by plants for growth, consequently the availability of nutrients increases [10].

In the cow manure dose treatment, the higher the number of tubers, the higher the number of leaves of the Dayak onion plant. In general, the number of tillers produces 3-4 leaves. This indicates that each increase in the number of tillers will increase the number of Dayak leaves [18]. The fresh and dry weight of tubers per sample fed with cow manure showed that the availability of nutrients contained in cow manure such as P and K elements could be absorbed optimally.

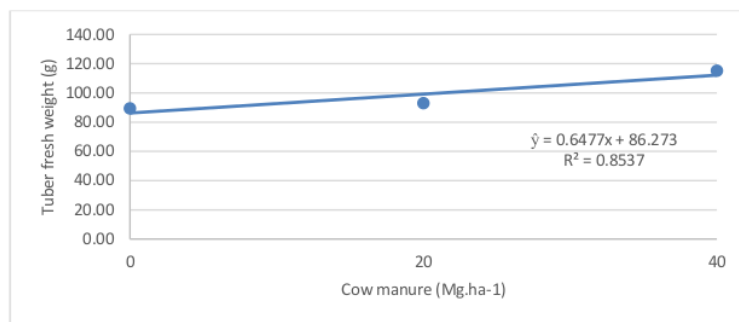


Figure 1. Graph of Dosage of Cow Manure Fertilizer on Fresh Weight Dayak Onion Plant Bulbs

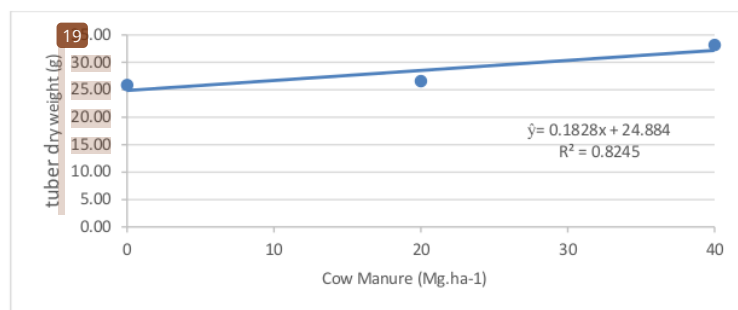


Figure 2. Graph of Dosage of Cow Manure Fertilizer to Dry Weight of Dayak Onion Bulbs

The application of cow manure fertilizer had a significant effect on the wet weight of tubers and had a very significant effect on the dry weight of plant tubers. The results showed that increasing the dose of fertilizer applied was followed by increase in growth and tuber weight of the Dayak onion plant treatment 40 Mg.ha⁻¹ (p₃) produces the highest wet weight and dry weight of tubers. The functional relationship between cow manure fertilization and tuber wet weight is linear with the equation = 0.6477x + 86.273 with a determinant coefficient (R²) = 0.8537, meaning that the dose of cow manure fertilizer (P) contribution to the wet weight of Dayak onion plants is 85.37 %, value (r) = 0.924 (Figure 1). The functional relationship between cow manure fertilization and tuber dry weight is linear, the equation = 0.1828x + 24.884 with the determinant coefficient (R²) = 0.8245, which means that the dose of cow manure fertilizer (P) on the dry weight of the Dayak onion plant is 82.45 %, value (r) = 0.908 (Figure 2). This shows that the application of cow manure fertilizer can increase the availability and uptake of N, P and K nutrients, in root crops such as Dayak onions, K is needed more than other nutrients [17].

3.2.3. Dosage of KCl Fertilizer (K)

The results of variance showed that the dose of KCl (K) fertilizer had no significant effect on the tables of plant height, fresh weight, dry weight and the number of tubers of Dayak onion plants. However, it had significant effect on the variable number of leaves 2 MST. Overall, it showed the best growth in treatment (k₃) with a dose of KCl fertilizer of 300 kg ha⁻¹. This is presumably because the KCl fertilizer dose treatment of potassium nutrients did not play a significant role in the growth of stems and leaves, because the potassium nutrient plays a more important role in the growth of seeds, fruits, and tubers. Elemental K plays a role in increasing photosynthetic activity and increasing carbohydrate metabolism and increasing plant fresh and dry weight. The balance of K nutrients in the soil plays a very important role in the synthesis of carbohydrates and proteins so that it really helps to enlarge tubers, potassium affects tuber quality by increasing tuber diversity and increasing tuber dry matter [19].

Although the application of KCl fertilizer had no significant effect, it showed that increasing the dose of KCl fertilizer could increase growth and yield from the variables of number of leaves, fresh weight, dry weight and number of tubers.

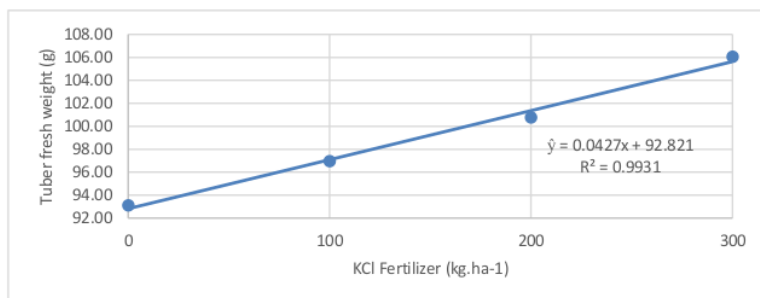


Figure 3. Graph of Kcl Fertilizer Dosage on Fresh Weight Dayak Onion Plant Bulbs

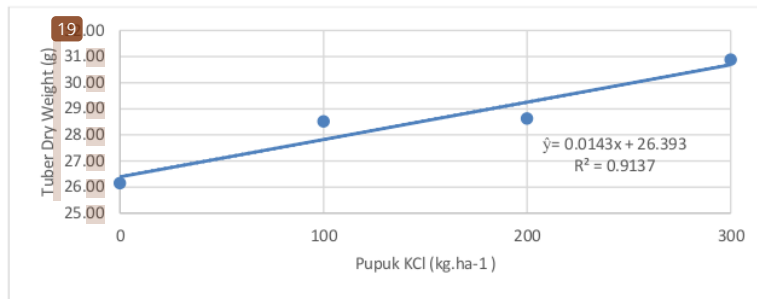


Figure 4. Graph of Dosage of Kcl Fertilizer on Dry Weight Of Dayak Onion Plant Bulbs

The relationship between KCl fertilization and tuber wet weight is linear with the equation $\hat{y} = 0,0427x + 92,821$ with determinant coefficient (R^2)= 0,9931, $r = 0,913$ (Figure 3). The relationship between KCl fertilization and tuber dry weight is linear with the equation $\hat{y} = 0,0143x + 26,393$ with determinant coefficient (R^2)= 0,9137; $r = 0,956$ (Figure 4).

IV. CONCLUSIONS AND SUGGESTIONS

4.1. Conclusion

Based on the results of research and discussion, conclusions can be drawn as follows:

- The interaction between cow manure and KCl fertilizer had significant effect on the variables of plant height, fresh weight, number of tubers and dry weight, but had a very significant effect on the variable number of leaves when the plants were 2 and 4 WAP. Interaction treatment between cow manure fertilizer dose of 40 Mg.ha⁻¹ and KCl fertilizer 300 kg.ha⁻¹ gave the best growth on the variable number of leaves, total freshweight, number of tubers and total dry weight.
- The application of cow manure fertilizer had a very significant effect on the variables of plant height, number of leaves, total freshweight, number of tubers and total dry weight. Provision of cow manure fertilizer of 40 Mg.ha⁻¹ produce the best Dayak onion growth.
- The application of KCl fertilizer had no significant effect on the variables of plant height, total freshweight, number of tubers and total dry weight, had a significant effect on the variable number of leaves when the plant was 2 WAP. Provision of KCl fertilizer with a dose of 300 kg.ha⁻¹ gave the best growth on the variable number of leaves, freshweight, number of tubers and dry weight.

4.2. Suggestion

Based on the research results, suggestions are put forward as follows:

- Based on the orthogonal results that are linear on the dose of cow manure fertilizer, it is necessary to do further research by increasing the dose of cow manure fertilizer.
- Further tests are needed to determine the dose of KCl fertilizer that can provide maximum growth for Dayak onion plants and on different lands.
- It is necessary to analyze the availability of nutrients in the soil before conducting research in order to determine the availability of existing nutrients so that the provision or addition of nutrients can provide maximum growth and yields for plants.

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