



## **GROWTH RESPONSE OF ROBUSTA COFFEE (*Coffea robusta* L.) GROWTH ON CHICKEN CAGE FERTILIZER AND FERTILIZER LIQUID ORGANIC**

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### **Abstract**

The purpose of this research is to know the response of robusta coffee seedling from the application of chicken manure and liquid organic fertilize. This research was held in land that are on Kecamatan Medan Johor road, North Sumatra with altitude  $\pm 32$  meters above the sea level, started from May until September 2016. This research was using factorial randomized block design with 2 factors. The first factor is the application of chicken manure (topsoil:manure) with four levels, namely: (1:0); (3:1); (2:1); (1:1) and the application of liquid organic fertilizer with four levels of 0 cc/l; 2 cc/l; 4 cc/l; 6 cc/l. The observed parameters were plant height (cm), stem diameter (mm), root volume (cm<sup>3</sup>), total leaf area (cm<sup>2</sup>), dry weight of root (g), dry weight of shoot (g), and shoot-root ratio. The result showed that chicken manure treatment significantly increased the plant height, stem diameter, root volume, total leaf area, dry weight of root, dry weight of root and shoot-root ratio. The application of liquid organic fertilizer significantly increased the total leaf area parameter. The interaction between both treatments significantly increased dry weight of root, dry weight of shoot and total leaf area parameters.

Keywords: seeds, Robusta coffee, chicken manure, POC

### **1. Introduction**

Coffee is an export commodity that is quite important for the Indonesian economy because foreign exchange earnings from coffee rank fourth after timber, rubber and palm oil. Indonesia is known as the third largest robusta coffee exporter in the world after Brazil and Colombia (Wachyar et al., 2002).

The composition of ownership of coffee plantations in Indonesia is dominated by People's Plantations (PR) with a portion of 96% of the total area in Indonesia, of which 2% are State Large Plantations (PBN) and 2% are Large Private Plantations (PBS). This position shows that the role of coffee farmers in the national economy is quite significant (Ditjenbun, 2013)

Statistical data for 2013 – 2015 the composition of robusta coffee plantations cultivated in Indonesia increased by 2% to reach 931,405 hectares, consisting of people's plantations covering an area of 894,146 hectares, state plantations 15,427 hectares, and private plantations 21,831 hectares (Ditjenbun, 2014)

The problem faced in coffee cultivation in Indonesia is the low quality of Indonesian robusta coffee. For this reason, currently coffee is mostly cultivated or produced organically with the term organic coffee (Winarni et al., 2013). Organic coffee cultivation can be used as an alternative in improving the quality of Indonesian robusta coffee. Organic coffee is an environmentally friendly agricultural product. Compared to using chemical (inorganic) fertilizers, the use of organic fertilizers will save garden maintenance costs by up to 30% (Arif et al., 2011)

In Indonesia, organically grown coffee is found in several areas. Several researchers have identified several organic coffees in several areas, such as in the Gayo highlands, Aceh, at PT. Nusantara XII plantations, East Java and in Menoreh, Central Java. Organic coffee is exported at a premium (Dradjat et al., 2007). In addition to improving quality, organic coffee cultivation can be used as an alternative in increasing the selling price. The background of consumer awareness of agricultural products that are free or very little using synthetic chemical inputs. This is reflected in the appreciation of consumers who are willing to pay higher prices for chemical-free food products compared to similar products produced conventionally. (Goenadi et al., 1997).

One source of organic nutrients that can be used to support organic coffee cultivation is manure. Manure has natural properties and does not damage the soil, providing macro (nitrogen, phosphorus, potassium, calcium, and sulfur) and micro elements (iron, zinc, boron, cobalt, and molybdenum). In addition, manure functions to increase water resistance, soil microbiological activity, cation exchange capacity and improve soil structure (Yuliana and Permanasari, 2015).

The application of organic fertilizers can improve the growth and productivity of coffee plants. This is because the application of organic fertilizers has a major role in supporting the improvement of physical, chemical and biological properties of the soil, as well as increasing the availability of nutrients in the soil (Kadir and Kanro, 2006).

## **2. Materials and Methods**

The research was carried out on land located on Jl. Karya Bakti, Ex. Pangkalan Mansyur, Kec. Medan Johor, North Sumatra, Medan at an altitude of  $\pm 32$  meters above sea level (asl). The research was conducted from May to September 2016.

The materials used in this study were Robusta coffee seeds aged 1 month from a nursery belonging to a farmer group (TANIRAS) Lau Cih Village, Medan Tuntungan District, North Sumatra (BP42 variety), topsoil, chicken manure (manure), organic fertilizer. liquid (POC), polybag with a size of 25 x 30 cm (5 kg), water and label. The tools used in this study were hoe, sickle, hammer, wire, pliers, paranet, bamboo, machete, sprayer, meter, caliper, plastic rope, glass beaker, scales, sample pacak, bucket and knife.

This study used a Randomized Block Design (RAK) with 2 factors. The results of the analysis of variance showed a significant effect, then continued with the Duncan Multiple Range Test (DMRT) and Orthogonal Polynomials at the 5% level.

### 3. Results and Discussion

#### Results

In the treatment, the concentration of liquid organic fertilizer had a significant effect on the observed variables of total leaf area. The interaction between chicken manure and liquid organic fertilizer had a significant effect on root dry weight, shoot dry weight and total leaf area.

#### Seedling Height

The observation data on the height of coffee seedlings aged 2-16 MSPT and its variance showed that chicken manure had a significant effect on the height of coffee seedlings aged 9-16 MSPT, the concentration of liquid organic fertilizer and the interaction of the two had no significant effect on the height of coffee seedlings.

Table 1. The height of coffee seedlings aged 2-16 MSPT on chicken manure treatment and concentration liquid organic fertilizer.

MSPT	Chicken Cage (topsoil:pukan)	POC concentration (ml/L)				Average
		P0 (0)	P1 (2)	P2 (4)	P3 (6)	
.....cm.....						
2	K0 (1:0)	8.21	7.31	7.77	8.10	7.85
	K1 (3:1)	7.54	7.76	7.43	6.62	7.34
	K2 (2:1)	6.32	7.07	7.58	7.61	7.14
	K3 (1:1)	8.01	8.06	7.04	8.02	7.78
	Average	7.52	7.55	7.46	7.59	7.53
3	K0 (1:0)	8.27	7.34	8.27	8.19	8.02
	K1 (3:1)	7.80	8.04	7.76	7.09	7.67
	K2 (2:1)	6.51	7.49	7.84	8.00	7.46
	K3 (1:1)	8.18	8.37	7.23	8.23	8.00
	Average	7.69	7.81	7.78	7.88	7.79
4	K0 (1:0)	8.34	7.83	8.57	8.34	8.27
	K1 (3:1)	8.07	8.24	8.01	7.82	8.04
	K2 (2:1)	6.90	7.81	8.13	8.53	7.84
	K3 (1:1)	8.59	8.56	7.57	8.64	8.34
	Average	7.98	8.11	8.07	8.34	8.12
5	K0 (1:0)	8.57	8.23	8.99	8.44	8.56
	K1 (3:1)	8.66	8.81	8.33	8.23	8.51
	K2 (2:1)	7.44	8.29	8.52	8.83	8.27
	K3 (1:1)	9.09	8.77	8.06	8.94	8.71
	Average	8.44	8.53	8.48	8.61	8.51
6	K0 (1:0)	8.76	8.47	9.40	8.77	8.85
	K1 (3:1)	10.01	9.29	8.59	8.79	9.17
	K2 (2:1)	7.78	9.17	8.91	9.40	8.81
	K3 (1:1)	9.91	8.92	8.49	9.34	9.17
	Average	9.11	8.96	8.85	9.08	9.00
7	K0 (1:0)	9.19	9.36	9.99	9.84	9.59
	K1 (3:1)	10.86	10.47	10.21	9.44	10.24
	K2 (2:1)	8.62	10.57	10.81	10.46	10.11
	K3 (1:1)	10.42	9.92	9.23	10.23	9.95
	Average	9.77	10.08	10.06	9.99	9.98
8	K0 (1:0)	9.30	9.93	10,40	10,14	9.94
	K1 (3:1)	11.74	11.37	11.08	10,30	11.12
	K2 (2:1)	9.27	11.60	12.27	11.56	11.17
	K3 (1:1)	11.27	10.42	9.87	10.93	10.62

MSPT	Chicken Cage (topsoil:pukan)	POC concentration (ml/L)				Average
		P0 (0)	P1 (2)	P2 (4)	P3 (6)	
	Average	10.39	10.83	10.90	10.73	10.72
9	K0 (1:0)	9.72	10.33	10.93	10.63	10.41b
	K1 (3:1)	13.18	12.30	12.22	11.08	12.19a
	K2 (2:1)	10.27	13.02	13.51	12.33	12.28a
	K3 (1:1)	12.51	11.28	10.36	11.78	11.48ab
	Average	11.42	11.73	11.76	11.46	11.59

Description: Numbers followed by the same letter in the same column or row and in the same week of observation showed no significant difference in the Test Duncan's Multiple Distance at level = 5%

Table 1 shows that at the age of 2-3 MSPT the highest coffee seedling height was obtained in the K0 treatment which was not significantly different from the other treatments. At the age of 4-6 MSPT the highest coffee seedling height was obtained in the K3 treatment which was not significantly different from the other treatments. At the age of 7 MSPT, the highest coffee seedling height was obtained in K1 treatment which was not significantly different from other treatments. At the age of 8-16 MSPT the highest coffee seedling height was obtained in K2 treatment where at the age of 8 MSPT it was not significantly different from other treatments, while at the age of 9-15 MSPT it was not significantly different from K1 and K3 treatments, but significantly different from K0, then at age 16 MSPT was significantly different from treatment K0 and K3, but not significantly different from treatment K1.

### Rod Diameter

The stem diameter of coffee seedlings in the treatment of manure and liquid organic fertilizer can be seen in Table 2. Observation data on stem diameter of coffee seedlings aged 2-16 MSPT and its variance showed that chicken manure had a significant effect on stem diameter of coffee seedlings aged 9-16 MSPT, concentration liquid organic fertilizer and their interaction had no significant effect on stem diameter of coffee seedlings.

Table 2. Stem diameter of coffee seedlings aged 2-16 MSPT on treatment of chicken manure and concentration of liquid organic fertilizer

MSPT	Chicken Cage (topsoil:pukan)	POC concentration (ml/L)				Average
		P0 (0)	P1 (2)	P2 (4)	P3 (6)	
		.....mm.....				
2	K0 (1:0)	1.70	1.63	1.89	1.73	1.74
	K1 (3:1)	1.71	1.64	1.70	1.69	1.68
	K2 (2:1)	1.49	1.60	1.75	1.66	1.62
	K3 (1:1)	1.66	1.69	1.62	1.76	1.68
	Average	1.64	1.64	1.74	1.71	1.68
3	K0 (1:0)	1.70	1.65	1.89	1.74	1.75
	K1 (3:1)	1.74	1.64	1.74	1.72	1.71
	K2 (2:1)	1.49	1.62	1.76	1.67	1.64
	K3 (1:1)	1.67	1.69	1.67	1.79	1.71
	Average	1.65	1.65	1.77	1.73	1.70
4	K0 (1:0)	1.72	1.72	1.90	1.76	1.78
	K1 (3:1)	1.77	1.67	1.77	1.74	1.74
	K2 (2:1)	1.57	1.66	1.81	1.72	1.69
	K3 (1:1)	1.72	1.71	1.70	1.84	1.74
	Average	1.69	1.69	1.79	1.77	1.74
	K0 (1:0)	1.76	1.77	1.94	1.82	1.82

5	K1 (3:1)	1.82	1.73	1.88	1.80	1.81
	K2 (2:1)	1.63	1.72	1.89	1.80	1.76
	K3 (1:1)	1.79	1.81	1.73	1.89	1.81
	Average	1.75	1.76	1.86	1.83	1.80
6	K0 (1:0)	1.82	1.79	2.02	1.82	1.86
	K1 (3:1)	1.83	1.78	1.89	1.80	1.83
	K2 (2:1)	1.66	1.79	1.93	1.81	1.80
	K3 (1:1)	1.83	1.84	1.75	1.96	1.84
Average	1.78	1.80	1.90	1.85	1.83	
7	K0 (1:0)	1.84	1.82	2.03	1.90	1.90
	K1 (3:1)	2.08	1.87	1.95	1.85	1.94
	K2 (2:1)	1.67	1.92	2.01	1.86	1.86
	K3 (1:1)	1.91	1.92	1.83	1.98	1.91
Average	1.88	1.88	1.96	1.90	1.90	
8	K0 (1:0)	1.85	1.88	1.98	1.92	1.91
	K1 (3:1)	2.20	1.97	2.05	2.00	2.05
	K2 (2:1)	1.70	2.14	2.23	2.05	2.03
	K3 (1:1)	2.03	2.09	1.98	2.12	2.06
Average	1.95	2.02	2.06	2.02	2.01	
9	K0 (1:0)	1.96	1.97	2.08	1.99	2.00b
	K1 (3:1)	2.32	2.16	2.23	2.10	2.20a
	K2 (2:1)	1.86	2.35	2.45	2.23	2.22a
	K3 (1:1)	2.19	2.19	2.09	2.30	2.19a
Average	2.08	2.17	2.21	2.16	2.15	

Description: Numbers followed by the same letter in the same column or row and in the same week of observation showed no significant difference in the Test Duncan's Multiple Distance at the level of = 5%.

Table 2 shows that at the age of 2-6 MSPT, the highest stem diameter of coffee seedlings was obtained in treatment K0 which was not significantly different from other treatments. At the age of 7, 10-15 MSPT, the highest stem diameter of coffee seedlings was obtained in treatment K1 where at age 7 MSPT was not significantly different from other treatments, while at the age of 10-15 MSPT it was not significantly different from K2 and K3, but significantly different from K0. . At ages 8, 9, and 16 MSPT, the highest stem diameter of coffee seedlings was obtained in treatment K2 where at age 8 MSPT was not significantly different from other treatments, while at age 9 MSPT it was not significantly different from treatments K1 and K3, but significantly different from K0, while at the age of 16 MSPT was not significantly different from K1 treatment, but significantly different from K0 and K3.

### Root Volume

Data for observing the volume of roots of coffee seedlings aged 16 MSPT and its variance can be seen in Appendix 68-71 which shows that chicken manure has a significant effect on root volume of coffee seedlings aged 16 MSPT, the concentration of liquid organic fertilizer and their interaction has no significant effect on root dry weight. coffee seeds.

Table 3. Root volume of coffee seedlings aged 16 MSPT in manure treatment chicken and concentration of liquid organic fertilizer.

Chicken Manure (topsoil:pukan)	POC concentration (ml/L)				Average
	P0 (0)	P1 (2)	P2 (4)	P3 (6)	
.....cm3.....					
K0 (1:0)	0.43	0.58	1.83	0.25	0.78b

Chicken Manure (topsoil:pukan)	POC concentration (ml/L)				Average
	P0 (0)	P1 (2)	P2 (4)	P3 (6)	
.....cm3.....					
K1 (3:1)	4.00	3.00	1.25	2.42	2.67a
K2 (2:1)	1.42	5.25	4.08	1.75	3.13a
K3 (1:1)	4.42	3.58	1.58	2.33	2.98a
Average	2.57	3.10	2.19	1.69	2.39

Description: Numbers followed by the same letter in the same column or row and in the same week of observation showed no significant difference in the Test Duncan's Multiple Distance at the level of = 5%.

The volume of coffee seed roots in the treatment of manure and liquid organic fertilizer can be seen in Table 3. Table 3 shows that at the age of 16 MSPT the highest root volume of coffee seeds was obtained in treatment K2, which was 3.13 cm<sup>3</sup>, which was significantly different from treatment K0, which was 0,78 cm<sup>3</sup> but not significantly different from the treatment K1 (2.67 cm<sup>3</sup>) and K3 (2.98 cm<sup>3</sup>)

### Total Leaf Area

Data on the total leaf area of coffee seedlings aged 16 MSPT and their variance can be seen in Appendix 72-74 which shows that chicken manure, liquid organic fertilizer concentration and their interaction have a significant effect on the total leaf area of coffee seedlings aged 16 MSPT.

Table 4. The total leaf area of coffee seedlings aged 16 MSPT in the treatment of chicken manure and concentration of liquid organic fertilizer

Chicken Manure (topsoil:pukan)	POC concentration (ml/L)				Average
	P0 (0)	P1 (2)	P2 (4)	P3 (6)	
.....cm3.....					
K0 (1:0)	74.90f	33.36g	190.65f	262.14f	140.26c
K1 (3:1)	711.54bcde	798.01abc	868,14ab	570.59de	737.07a
K2 (2:1)	784.39abcd	975.04a	577,40cde	611.44cde	737.07a
K3 (1:1)	662.51bcde	757,16abcd	530.42e	511.35e	615.36b
Average	558,33ab	640.89a	541.65ab	488,88b	557.44

Description: Numbers followed by the same letter in the same column or row and in the same week of observation showed no significant difference in the Test Duncan's Multiple Distance at the level of = 5%.

Table 4 shows that at the age of 16 MSPT the highest total leaf area of coffee seedlings was obtained in treatments K2 and K1, namely 737.07 cm<sup>2</sup> which was significantly different from treatments K0 (140,26 cm<sup>2</sup>) and K3 (615.36 cm<sup>2</sup>). At the age of 16 MSPT the highest total leaf area of coffee seedlings was obtained at a concentration of liquid organic fertilizer 2 ml/L (P1), which was 640.89 cm<sup>2</sup> which was significantly different from the P3 treatment, which was 488.88 cm<sup>2</sup> and at the age of 16 MSPT the interaction between manure the highest chicken and liquid organic fertilizer was obtained in the K2P1 treatment (975.04 cm<sup>2</sup>) and the lowest was in the K0P0 treatment (74.90 cm<sup>2</sup>)

## Root Dry Weight

Table 5. Root dry weight of coffee seedlings aged 16 MSPT on chicken manure treatment and concentration liquid organic fertilizer

Chicken Manure (topsoil:pukan)	POC concentration (ml/L)				Average
	P0 (0)	P1 (2)	P2 (4)	P3 (6)	
K0 (1:0)	0.13e	0.27de	0.73cde	0.20de	0.33b
K1 (3:1)	1.53ab	0.93bcd	0.83bcde	1.10bc	1.10a
K2 (2:1)	0.43cde	1.87a	1.17abc	0.67cde	1.03a
K3 (1:1)	0.93bcd	1.07bc	0.63cde	0.70cde	0.83a
Average	0.76	1.03	0.84	0.67	0.83

Description: Numbers followed by the same letter in the same column or row and in the same week of observation showed no significant difference in the Test Duncan's Multiple Distance at the level of = 5%.

Root dry weight of coffee seedlings in the treatment of manure and liquid organic fertilizer can be seen in Table 5. Observation data on dry weight of roots of coffee seedlings aged 16 MSPT and its variance can be seen in Appendix 75-77 which shows that chicken manure has a significant effect on root dry weight. coffee seedlings aged 16 MSPT, the concentration of liquid organic fertilizer had no significant effect on root dry weight of coffee seedlings, and the interaction between the two treatments had a significant effect on root dry weight of coffee seedlings aged 16 MSPT.

Table 5 shows that at the age of 16 MSPT, the highest root dry weight of coffee seedlings was obtained in treatment K1 (1.10 g) which was significantly different from treatment K0 (0.33 g), but not significantly different from treatment K2 (1.03 g). and K3 (0.83 g).

## Head Dry Weight (g)

Table 6. The dry weight of the crown of coffee seedlings aged 16 MSPT in the treatment of chicken manure and concentration of liquid organic fertilizer.

Chicken Manure (topsoil:pukan)	POC concentration (ml/L)				Average
	P0 (0)	P1 (2)	P2 (4)	P3 (6)	
K0 (1:0)	0.77f	1.00ef	1.56def	0.77f	1.02c
K1 (3:1)	4.63abc	3.63bcd	3.17bcde	3.73bcd	3.70ab
K2 (2:1)	2.33cdef	6.90a	4.73ab	3.13bcde	4.27a
K3 (1:1)	3.57bcd	3.27bcde	2.33cdef	2.8bcdef	2.99b
Average	2.83	3.70	2.95	2.61	3.02

Description: Numbers followed by the same letter in the same column or row and in the same week of observation showed no significant difference in the Test Duncan's Multiple Distance at the level of = 5%.

Observation data on shoot dry weight of coffee seedlings aged 16 MSPT and its variance can be seen in Appendix 78-80 which shows that chicken manure has a significant effect on root dry weight of coffee seedlings aged 16 MSPT, concentration of liquid organic fertilizer has no significant effect on root dry weight of seedlings. coffee, and the

interaction between the two treatments had a significant effect on shoot dry weight of coffee seedlings aged 16 MSPT.

Table 6 shows that at the age of 16 MSPT, the highest root dry weight of coffee seedlings was obtained in treatment K2 (4.27 g) which was significantly different from treatment K0 (1.02 g) and K3 (2.99 g), but not significantly different from K1 treatment (3.70 g).

### Root-Top Ratio

Table 7. Root-root ratio of coffee seedlings aged 16 MSPT on chicken manure treatment and concentration liquid organic fertilizer.

Chicken Manure (topsoil:pukan)	POC concentration (ml/L)				Average
	P0 (0)	P1 (2)	P2 (4)	P3 (6)	
.....g.....					
K0 (1:0)	5.67	5.25	2.49	5.28	4.67b
K1 (3:1)	2.88	4.57	4.01	3.36	3.71a
K2 (2:1)	5.68	3.64	4.20	5.16	4.67a
K3 (1:1)	4.18	3.13	3.89	4.00	3.80a
Average	4.60	4.15	3.65	4.45	4.21

Description: Numbers followed by the same letter in the same column or row the same and on the same week of observation showed no significant difference in the Distance Test Duncan's multiple at the level of = 5%

The observation data on the shoot-root ratio of coffee seedlings aged 16 MSPT and its variance can be seen in Appendix 81-84 which shows that chicken manure has a significant effect on the shoot-root ratio of coffee seedlings aged 16 MSPT, the concentration of liquid organic fertilizer and the interaction of the two have no significant effect. on root dry weight of coffee seeds.

Table 7 also shows that at the age of 16 MSPT, the highest shoot-root ratio of coffee seedlings was obtained at a concentration of 2 ml/L (P1) liquid organic fertilizer which was not significantly different from the other treatments.

### 4. Conclusion

Chicken manure treatment significantly increased seedling height, stem diameter, root volume, total leaf area, root dry weight and shoot dry weight to a certain extent. Liquid organic fertilizer treatment had no significant effect on seedling height, stem diameter, root volume, root dry weight, crown dry weight and crown-root ratio but significantly increased the total leaf area to a certain extent. The interaction between chicken manure and liquid organic fertilizer had no significant effect on seedling height, stem diameter, root volume, and root-to-root ratio but had a significant effect on root dry weight, shoot dry weight and total leaf area.

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