



Effect of Cow Manure on Growth and Production of Peanut Plants in Sub Optimal Land

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The study aimed to determine the effect of cow manure on the growth and yield of peanut plants

Study Design: The experiment was laid out in a randomized block design (RBD) with five treatments including the control replicated three (3) times.

Place and Duration of Study: the Field Laboratory of the Faculty of Agriculture and the Laboratory of the Department of Agrotechnology, Faculty of Agriculture, Halu Oleo University, from June to October 2019

Methodology: without cow manure (B0), using cow dung 5 t/ha(B1), 10 t/ha(B2), 15 t/ha(B3) and 20 t/ha(B4). The treatment was repeated 3 times, so that there were 15 experimental units. The variables observed were plant height, number of branches, number of leaves, leaf area, dry weight, number of pods formed, number of filled pods and productivity of peanut plants. Observation data were analyzed using variance, F-count which showed a real or very real effect followed by Duncan's Multiple Range Test (DMRT) at the 95% confidence level.

Results: The results showed that cow manure treatment increased the growth of peanut plants especially the treatment cow manure at the dose of 15 t/ha in the form of filled pods, number of pods formed, and peanut plant productivity were 27.00, 35.93, and 3.62 t/ha at sub-optimal land.

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The application of cow manure can increase the availability of phosphorus in the soil and increase crop production. Cow manure has a phosphorus nutrient content of 0.42, 0.38 and 0.43 ppm respectively.

Conclusion: Treatment of cow manure at a dose of 15 t/ha was showed the best growth and production of peanut plants compared to other treatments.

Keywords: Sub-optimal land; cow manure; peanut.

1. INTRODUCTION

Peanuts are one type of Indonesian agricultural product that is widely consumed as a source of protein. Peanuts are used as food ingredients that are consumed directly or a mixture of foods such as bread, kitchen spices, and industrial raw materials so that the need for peanuts continues to increase every year in Indonesia. The increase in demand for peanuts must be accompanied by agricultural production of peanuts. But several areas in Indonesia like Southeast Celebes Province has low production of peanuts.

The low production of peanuts was influenced by the low level of soil fertility, including the soil in Southeast Celebes which is generally dominated by sub-optimal land. Sub-optimal land for agriculture is generally faced with several problems, including high soil acidity and toxicity of Fe and Al as well as deficiency of nutrients N, P, K, Ca and Mg. [1]. Apart from low soil fertility, the availability of organic matter is also a limiting factor in plant cultivation. Lack of availability of organic matter causes plant management in the community to use inorganic materials. Whereas the addition of inorganic materials can cause residues and kill microorganisms in the soil. With these conditions, it causes sub-optimal land management in Southeast Sulawesi to be less than optimal. One of the sub-optimal land management techniques is to apply good cultivation techniques to increase plant productivity, one of which is the use of organic fertilizers [1,2].

Organic fertilizers are fertilizers derived from the remains of plants, animals, such as manure, compost, green manure, straw, and other materials that can play a role in improving the physical, chemical and biological properties of the soil. The organic fertilizer that is widely used by farmers is cow manure. Cow manure has been tested to increase plant growth [3,4]. The increase in plant growth is due to the presence of nutrients contained in cow manure to supply plant needs. Furthermore, the use of cow manure can increase plant growth in marginal

soils. Based on the advantages of cow manure, this study was conducted to determine its effect on sub-optimal land [3,5].

2. MATERIALS AND METHODS

2.1 Description of the Study Area

This study was conducted at the Field Laboratory of the Faculty of Agriculture and the Agrotechnology Laboratory of the Agronomy Unit, Faculty of Agriculture, Halu Oleo University which lies in South East Celebes, Indonesia. The weather in study field both rainfall and sunny were erratic here average annual rainfall was 100-400mm from June 2019 to October 2019.

The materials used are peanut seeds, cow manure, treatment labels, tarpaulin, dibble, water and local microorganisms. The tools used are hoes, machetes, shovels, gauges, scales, ovens, rulers, watering can, scissors, cameras and stationery.

2.2 Experimental Design and Treatment Allocation

This study used a Randomized Block Design (RBD) with cow manure treatment consisting of 5 levels, without cow manure (B0), using cow manure 5 t/ha(B1), 10 t/ha(B2), 15 t/ha(B3) and 20 t/ha(B4). The treatment was repeated 3 times, so that there were 15 experimental units.

2.3 Field Study

Land preparation in this study was to clear weeds on the land. After the land was cleared, soil cultivation was carried out. Soil processing was carried out twice, namely processing using a tractor to overturn the soil. After the land was turned over, the second step was to loosen the soil using a hoe. After being ejected, then making a group map with a distance of 50 cm, in the group a treatment plot with a distance of 30 cm was made. Fertilization was dry cow manure sourced from the local farm and carried out by providing cow manure which was applied 1 week before planting.

Planting was done by planting the peanut seeds in a hole that have been made. The spacing used was 30 cm x 20 cm. Peanut seeds are inserted into the planting hole that has been made, as much as one seed per planting hole. Stitching is done to replace plants that do not grow or die. Stitching was done 7 days after planting. Other agronomic management practices were including watering, planting, weeding, and spraying pests. Weeding is done by removing or cleaning the weeds that grow in the experimental plots so that there is no competition for nutrient uptake and there is no influence of weeds on peanut plants. Watering is carried out according to field capacity. The heading is done at the age of the plants before 28 DAP.

2.4 Data Collection and Analysis

Plant growth was measured at the ages of 14, 28, 42 and 56 Day After Planting (DAP) to five representative plant samples were obtained from each plot. Parameters measured sampled plants were plant height, the number of branches, Number of leaves (strands), leaf area which measured all the leaves from each peanut plant; Leaf area was determined using the formula: $LA = 0.76 L \times 0.34 W$. Where LA = Leaf Area (cm²), L = Leaf length (cm), W = Leaf width (cm), 0.34 and 0.76 are constants and for the average = (leaf area per plant × plant number per plot)/plot area, Plant dry weight (biomass) was measured by taking samples in each treatment and oven at 70°C for 2 x 24 hours and then weighing the plants that had been ovenized. Weight measurements were carried out at the ages of 14, 28, 42 and 56 DAP.

Production Plants was measured at the number of pods formed, the number of filled and empty pods, calculated by counting the number of pods after harvest and productivity (ton ha⁻¹). Observation data were analyzed using analysis of variance (ANOVA). Data that shows a real or very real effect is continued with the Duncan Multiple Range Test (DMRT) at P=0.05

3. RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1 Plant height

The results of DMRT at the 95% confidence level of the average height of peanut plants aged 14, 28 and 42 DAP applied cow manure are presented in Table 1. Table 1 shows that cow

manure treatment has a different effect on the average height of peanut plants. soil aged 14, 28 and 42 DAP. The best average height of peanut plants aged 14 DAP was obtained in the 15 t/ha dose of cow manure treatment of 5.86 cm compared to other treatments, although statistically, it showed no significant effect. The best average height of peanut plants aged 28 DAP was obtained in the treatment of cow manure at a dose of 15 t/ha with a plant height of 12.75 cm which was not significantly different from the treatment of cow manure at a dose of 10 and 20 t/ha but different real with the treatment of cow manure dose of 5 t/ha and without treatment of cow manure. The best average height of peanut plants aged 42 DAP was obtained in the treatment of cow manure at a dose of 15 t/ha with a plant height of 22.23 cm which was not significantly different from the treatment of cow manure at dose 10, and 20 t/ha but significantly different with no cow manure treatment.

3.1.2 Number of branches

The average number of peanut branches aged 14, 28 and 42 DAP applied cow manure are presented in Table 2. Table 2 shows that the treatment of cow manure has a different effect on the average number of branches. Peanut plants aged 14, 28 and 42 DAP. The best average number of peanut branches aged 14 DAP was obtained in the 15 t/ha dose of cow manure treatment of 1.73 compared to other treatments, although statistically it showed no significant effect. The best average number of peanut branches aged 28 DAP was obtained in the treatment of cow manure dose of 15 t/ha with a number of branches of 4.67 which was not significantly different from the treatment of cow manure at dose 10, and 20 t/ha significantly different from the treatment of cow manure at a dose of 5 t/ha and without treatment. The best average number of peanut branches aged 42 DAP was obtained in the treatment of cow manure at a dose of 15 t/ha with a number of branches of 6.87 which was not significantly different from the dose of cow manure treatment, 20 t/ha but significantly different with the treatment of cow manure at a dose of 5, 10 t/ha and without treatment of cow manure.

3.1.3 Number of leaves

The average number of peanut leaves aged 14, 28 and 42 DAP applied cow manure are presented in Table 1. Table 3 shows that the

treatment of cow manure has a different effect on the average number of leaves. peanut plants aged 14, 28 and 42 DAP. The best average number of peanut leaves aged 14 DAP was obtained in the 15 t/ha dose of cow manure treatment of 6.80 pieces compared to other treatments, although statistically it showed no significant effect. The best average number of leaves of peanut plants aged 28 and 42 DAP was obtained in the treatment of cow manure at a dose of 15 t/ha with a number of leaves of 20.33 and 36.53 strands that were not significantly different from the treatment of cow manure at a dose of 20 t/ha but significantly different from the treatment of cow manure at a dose of 5, 10 t/ha and without treatment of cow manure.

3.1.4 Leaf area

The leaf area average of peanuts aged 14, 28 and 42 DAP applied cow manure are presented in Table 4. Table 4 shows that cow manure treatment has a different effect on the average leaf area peanut plants aged 14, 28 and 42 DAP. The best average leaf area of peanut plants aged 14 DAP was obtained in the treatment of cow manure at a dose of 15 t/ha with a leaf area of 85.90 cm² compared to other treatments, although statistically it showed no significant effect. The best average leaf area of peanut plants aged 28 DAP was obtained in the treatment of cow manure at a dose of 15 t/ha with a leaf area of 468.66 cm² which was not significantly different from the treatment of cow manure at dose 10, and 20 t/ha but significantly different from the treatment of cow manure at a dose of 5 t/ha and without treatment of cow manure. The best average leaf area of peanut

plants aged 42 DAP was obtained in the treatment of cow manure at a dose of 15 t/ha with a leaf area of 1227.55 cm² which was not significantly different from the dose of cow manure treatment, 20 t/ha but different. Real with the treatment of cow manure at a dose of 5, 10 t/ha and without treatment of cow manure.

3.1.5 Dry weight

The dry weight average of peanut plant age 14, 28 and 42 DAP applied cow manure are presented in Table 5. Table 5 shows that cow manure treatment has a different effect on the average weight. Dry peanut crop aged 14, 28 and 42 DAP. The best average dry weight of peanut plant age 14, 28 and 42 DAP was obtained in the treatment of cow manure with a dose of 15 t/ha with dry weight of 0.73, 2.57 and 10.75 g, which were not significantly different with treatment Cow manure at dose 10, and 20 t/ha but significantly different from the treatment of cow manure dose 5, and without treatment of cow manure.

3.1.6 Fill pods

Filled pods Average of peanut plants applied to cow manure are presented in Fig. 1. Fig. 1 shows that cow manure treatment has a different effect on the average filled pods of peanut plants. The average number of the best filled pods was obtained in the treatment of cow manure dose of 15 t/ha with the number of filled pods of 27.00 which was not significantly different from the treatment of cow manure at doses of 5, 10 and 20 t/ha but significantly different from without the treatment.

Table 1. High average (cm) of peanut plants at 14, 28 and 42 DAP with cow manure treatment

Levels	Plants Age (DAP)					
	14	28	42			
B0	4.97	a	9.19	d	12.53	c
B1	5.23	a	10.37	c	16.15	bc
B2	5.51	a	11.49	bc	18.14	ab
B3	5.86	a	12.75	a	22.23	a
B4	5.43	a	11.88	ab	19.03	ab
DMRT α 0.05	ns		2=	1.152	2=	4.799
			3=	1.201	3=	5.001
			4=	1.228	4=	5.114
			5=	1.244	5=	5.182

*Figures followed by different letters in the same column are stated differently based on Duncan's Multiple Range Test (P=0.05)

Table 2. Number of branches average (cm) of peanut plants at 14, 28 and 42 DAP with cow manure treatment

Levels	Plant Age (DAP)					
	14		28		32	
B0	1.33	a	3.60	c	4.27	b
B1	1.87	a	4.07	bc	4.87	b
B2	1.73	a	4.13	abc	4.93	b
B3	2.07	a	5.07	a	6.87	a
B4	1.73	a	4.67	ab	5.67	ab
DMRT α 0.05	ns		2=	0.8964	2=	1.382
			3=	0.9341	3=	1.44
			4=	0.9552	4=	1.473
			5=	0.9679	5=	1.492

* Figures followed by different letters in the same column are stated differently based on Duncan's Multiple Range Test ($P=0.05$)

Table 3. Number of Leaves Average (cm) of Peanut Plants at 14, 28 and 42 DAP with cow manure treatment

Levels	Plant Age (DAP)					
	14		28		32	
B0	5.67	a	14.00	b	24.90	c
B1	6.00	a	16.67	b	27.93	bc
B2	6.40	a	16.73	b	28.47	bc
B3	6.80	a	20.33	a	36.53	a
B4	5.53	a	15.73	b	31.40	ab
DMRT α 0.05	ns		2=	2.725	2=	5.641
			3=	2.84	3=	5.878
			4=	2.904	4=	6.011
			5=	2.942	5=	6.091

* Figures followed by different letters in the same column are stated differently based on Duncan's Multiple Range Test ($P=0.05$)

Tabel 4. Leaf Area Average (cm) of Peanut Plants at 14, 28 and 42 DAP with cow manure treatment

Levels	Plant Age (DAP)					
	14		28		32	
B0	57.88		230.14	c	695.19	c
B1	60.12		303.32	bc	789.87	bc
B2	68.21		414.10	a	868.93	bc
B3	85.90		468.66	a	1227.55	a
B4	71.61		377.32	ab	1026.66	ab
DMRT α 0.05	ns		2=	93.8	2=	278.8
			3=	97.7	3=	290.5
			4=	99.9	4=	297.1
			5=	101.3	5=	301.0

* Figures followed by different letters in the same column are stated differently based on Duncan's Multiple Range Test ($P=0.05$)

Table 5. Dry Weight Average (cm) of Peanut Plants at 14, 28 and 42 DAP with cow manure treatment

Levels	Age Plants (DAP)					
	14		28		32	
B0	0.55	b	1.11	c	4.12	c
B1	0.55	b	1.82	b	8.59	b
B2	0.70	a	2.22	ab	9.05	ab
B3	0.73	a	2.57	a	10.75	a
B4	0.72	a	2.44	ab	10.07	ab
DMRT α 0.05	2=	0.093	2=	0.624	2=	1.98
	3=	0.0969	3=	0.65	3=	2.063
	4=	0.991	4=	0.665	4=	2.11
	5=	0.1004	5=	0.673	5=	2.138

*Figures followed by different letters in the same column are stated differently based on Duncan's Multiple Range Test ($P=0.05$)

3.1.7 Pods formed

The average pods formed peanut plants applied to cow manure are presented in Fig. 2. Fig. 2 shows that cow manure treatment has a different effect on the average pods formed peanut plants. The best average number of pods formed was obtained in the treatment of cow manure at a dose of 15 t/ha with a number of pods of 35.93 which was not significantly different from the treatment of cow manure at doses of 5, 10 and 20 t.ha⁻¹ but different with no cow manure application.

3.1.8 Productivity

Productivity of peanut plants applied to cow manure are presented in Fig. 3. Fig. 3 shows that cow manure treatment has a different effect on the average productivity of peanut plants. The best average productivity was obtained in the treatment of cow manure at a dose of 15 t/ha with a productivity of 3.62 t/ha which was not significantly different from the treatment of cow manure at doses of 5, 10 and 20 t/ha but significantly different without the application of cow manure.

3.2 Discussion

Plant productivity on marginal land can be increased by using organic fertilizers which are able to increase the availability of nutrients and the microbial population inside which has implications for increasing plant growth and yield. Organic fertilizers that are widely distributed are cow manure which has not been used optimally. Cow manure has high nutrient content in the form of C, N P, Ca, and Mg.

The results showed that cow manure had a significant effect on plant growth and production. Treatment of manure at a dose of 15 t/ha had higher growth than the control (Tables 1-5). There was an increase in plant growth; presumably there was a supply of nutrients in the soil from organic fertilizers so that it could be absorbed by plants. There are many nutrients needed by plants, especially nitrogen which is needed to stimulate vegetative growth, increase chlorophyll, and increase the size of leaves and seeds. The negative effects of N deficiency on leaf photosynthetic capacity, decreases in both Photosynthetic rate and leaf area due to N deficiency are major causes limiting plant growth and productivity [6,7]. Chlorophyll plays an important role in the process of photosynthesis, which functions as a catcher for sunlight [8]. In addition to nitrogen, the presence of magnesium in organic fertilizers can increase chlorophyll levels in plants. Magnesium plays an important role in the process of chlorophyll formation in plant leaves. The high chlorophyll content can increase the rate of photosynthesis and increase photosynthate for plants as seen in the increase in dry weight of peanut crop (Table 5). The resulting photosynthate can be translocated to all parts of the plant so that it can grow and develop optimally.

In addition to increasing plant growth, the application of cow manure can increase the yield components of peanut crops. The results showed that the application of organic fertilizer based on cow manure could increase crop yields in the form of filled pods, number of pods formed, and peanut plant productivity (Figs. 1-3). The application of organic fertilizers based on cow manure can increase the availability of phosphorus in the soil and increase crop

production. The elevated soil P on the count of excess manure application is an indicator of its potential transfer from the manure. All the P forms except water P were strongly related to total P in the soil [9].

Phosphorus plays a role in helping in cell division, enzyme activation and carbohydrate

metabolism [10]. The presence of phosphorus can increase the photosynthate produced in pea plants and translocated in the process of forming plant pods and filling seeds. The presence of calcium in the soil can also reduce the loss of ovules and the formation of pods in the soil [11].

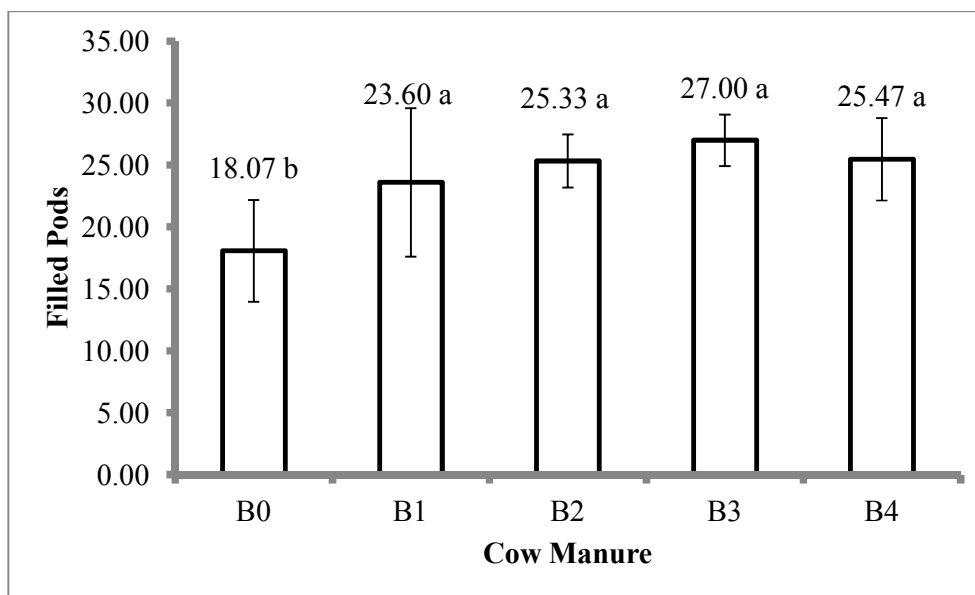


Fig. 1. Effect of cow manure on the average filled pods of peanut plants

Note: The error bar shows the standard deviation and the numbers on the error bar followed by different letters in the same column are stated differently based on DMRT α 0.05

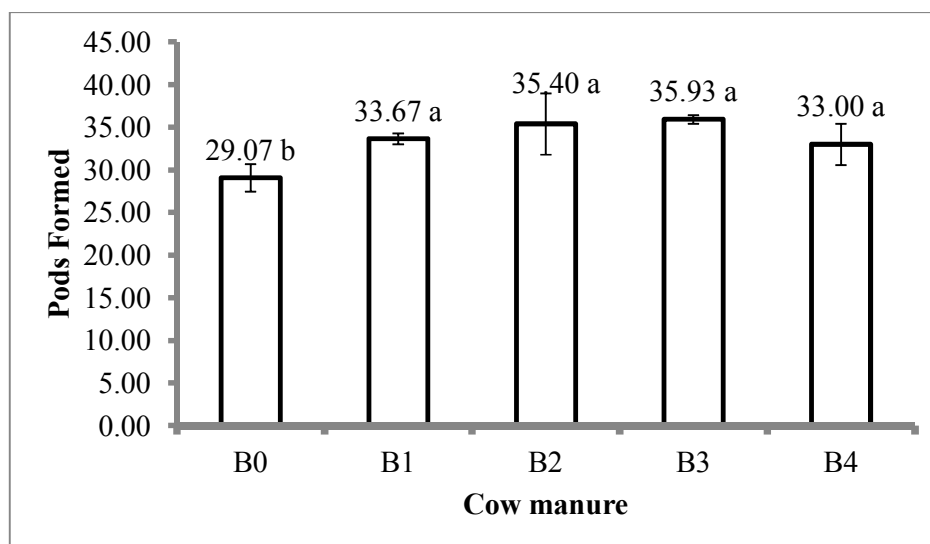


Fig. 2. Effect of cow manure on the average pods formed of peanut plants

Note: The error bar shows the standard deviation and the numbers on the error bar followed by different letters in the same column are stated differently based on DMRT α 0.05

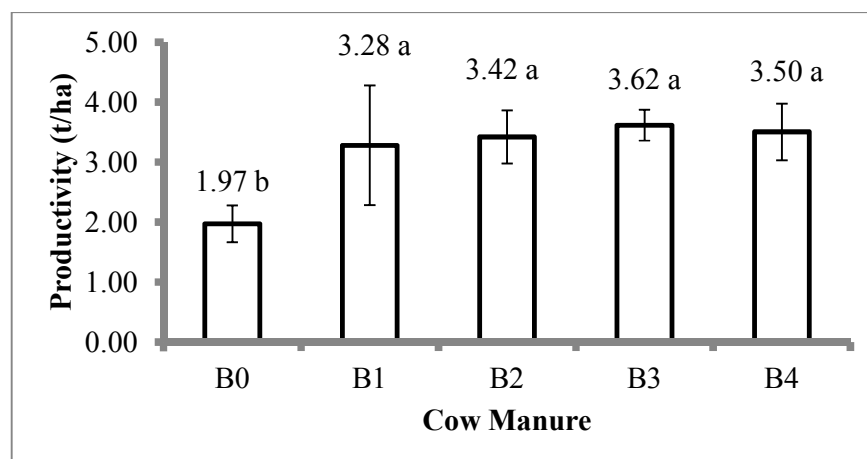


Fig. 3. Effect of cow manure on the average productivity of peanut plants

Note: The error bar shows the standard deviation and the numbers on the error bar followed by different letters in the same column are stated differently based on DMRT α 0.05

In addition to increasing the availability of nutrients in the soil directly, organic fertilizers can improve soil physical properties [12,13]. The application of cow manure had a very significant effect on soil weight, soil porosity, soil moisture content and soybean yield [14]. The results showed that the treatment of organic fertilizers was able to increase the soil moisture content compared to those without organic fertilizers. Organic fertilizers added to the soil can increase water, so that it can be available for plant growth [13]. The ability of soil to increase water is due to organic matter which can reduce soil weight [15]. Soils that have low fill weight can increase soil porosity. Organic matter that has undergone weathering has a high enough ability to store water because it is hydrophilic, so there can be an increase in available water pores [16,17]. Manure undergoes a decomposition process and gradually produces humus and then interacts with soil particles to create a more stable soil structure and enlarge the pore space. The existence of pore space in the soil can increase soil permeability. Soil with high permeability increases the infiltration rate and decreases the rate of water in the soil. Furthermore, the available pore water greatly determines the value of water content. The higher the available pore value, the higher the soil water content. Soils that have high small and medium pores will tend to hold water stronger than soil that has many large pores [17].

Soil organic matter has more pores than soil mineral particles, which means that the surface area of absorption is also more, so that the

higher the soil organic matter content, the higher the content and availability of ground water [17,18]. Soil that has more pore space will be able to store more water. Because the soil pore space will be filled with water and in the end it will have a higher soil moisture than all soil moisture, both wind dry moisture content, field capacity moisture content and maximum moisture content. Organic matter can increase water content in the soil, can maintain the stability of water content in the soil and temperature in the soil [17,19,20]. Therefore, using organic fertilizer based on cow manure can maintain plant productivity in drought stress conditions due to low intensity and time of rainy days.

Any change in physical and chemical properties can result in changes in the microbial community in the soil. The addition of cow manure can increase the microbial population in the soil and increase the availability of nutrients needed by plants [21,22]. Reported that the use of vermicast and manure can increase the diversity of microbes in the soil.

The addition of cow manure in the soil is thought to increase the number of *Rhizobium leguminosarum* bacteria which can support plant growth and yield. The application of organic fertilizers can increase the number of root nodules in plants [23]. Nitrogen-fixing microbes are highly dependent on carbon stocks in the soil and organic carbon sources which are important for enzyme activity in their development process [24]. It found bacterial diversity, in terms of both

species richness and evenness, where the treatment using poultry manure was higher than that of inorganic fertilizers [25]. *Rhizobium leguminosarum* symbiosis with plant roots that fix nitrogen from the air. *Rhizobium leguminosarum* can convert nitrogen from air (N₂) to ammonium (NH₄⁺) [10] so that it can be available for plant growth.

4. CONCLUSION

The treatment of cow manure increases the growth and yield of peanut plants in sub-optimal land and the dose of 15 t/ha showed the best growth and production of peanut plants compared to other treatments.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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