

**Research Article****Aplikasi Limbah Gypsum dan Pupuk Organik pada Pertumbuhan dan Hasil Tanaman Kacang Tanah (*Arachis hypogea* L.) di Tanah Ultisol*****Application of Gypsum Waste and Organic Fertilizer on Growth and Yield of Peanut (*Arachis hypogea* L.) in Ultisol Soil*****Deni Pratama<sup>1\*</sup>, Tri Lestari<sup>1</sup>, dan Dini Febriyani<sup>1</sup>**<sup>1</sup> *Agrotechnology Departement, Faculty of Agriculture, Fisheries, and Marine, Universitas Bangka Belitung, Jl. Raya Balunijuk, Bangka 33215*

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**ABSTRACT**

*Peanut is an important agricultural commodity in Indonesia as a protein and vegetable oil source. Soil conditions in Indonesia are usually ultisol soils that have low pH and nutrients, this is an obstacle in peanut cultivation. This study was conducted to determine the effect of a combination of calcite sources and organic fertilizers on the growth and yield of peanut in ultisol soil. This research was conducted from May to August 2024 at UPTD Balai Benih Pertanian Air Pelempang, Bangka Regency. The research used a split-plot randomized group design. The main plot was without a calcite source (P1), agricultural calcite (P2), and gypsum waste (P3). Subplots were commercial compost (K1), chicken manure (K2), and cow manure (K3). Data analysis was performed using an analysis of variance with a significant level of 95% and a follow-up test with Duncan's Multiple Range Test with a significant level of 95%. The results showed that the treatment of calcite sources from agricultural calcite was better than the treatment of gypsum waste and without calcite sources. The treatment of organic fertilizer from chicken manure was better than cow manure and commercial compost. The combination that gave the best results with the highest value was agricultural calcite and chicken manure fertilizer, which affected all parameters except the percentage of effective root nodules, root dry weight, and flowering age. Gypsum waste has the potential to be a substitute for agricultural calcite when combined with chicken manure fertilizer, as it does not have significant results with agricultural calcite.*

**Keywords: Calcite; gypsum waste; organic fertilizer; peanut; ultisol soil****1. Introduction**

Peanut in Indonesia (*Arachis hypogaea* L.) are an important agricultural commodity and have a strategic role in national food as a protein and vegetable oil source. Based on data from the Direktorat Jenderal Tanaman Pangan (2022), peanut production in Indonesia of 2020-2022 decreased from 418,414 tons of dry matter to 379,928 tons of dry matter, and in Bangka Belitung, there was also a decrease in peanut production in 2020-2022 from 213 tons of dry matter to 182 tons of dry matter. One of the factors causing low peanut

production in Bangka Belitung is soil type. The type of soil in Bangka Belitung is Ultisol, which has low soil fertility (Kharolina et al., 2023).

Ultisol soil is soil that has a low pH (acid) of <5.0 with high Al saturation, low organic matter and nutrient content, it becomes a constraint factor for peanut cultivation (Firdany et al., 2021). The results of research by Rahmianna et al. (2015) stated that peanut in soil with low pH can reduce pod or seed yields, the pods formed are less fleshy and root nodules are inhibited. Land with acidic soil pH can also cause Al, Fe, and Mn poisoning. The high content of these nutrients will inhibit root growth

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and translocation of P and Ca to plants, and the availability of nutrients will decrease (Hartati et al., 2023). One way to overcome acidic soil pH in ultisol soil is by adding lime.

Lime is used to increase soil pH and prevent the potential toxicity of microelements such as Al in plants, in addition to being a source of calcium nutrients (Saputro et al., 2017). One type of lime that is commonly used is agricultural calcite. According to Dariah et al. (2015), agricultural calcite is usually made from calcite limestone which has the chemical formula  $\text{CaCO}_3$ . The demand for agricultural calcite, which will increase every year, can cause limited availability. Bangka Belitung has a  $\text{CaCO}_3$  potential similar to agricultural calcite, which is gypsum waste ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ). Gypsum waste results from the desulfurization process of burning tin ore at the Unit Metalurgi Muntok owned by PT Timah Tbk. The XRD analysis test by PT Timah shows that gypsum waste contains 85.6% calcite ( $\text{CaCO}_3$ ), so it can be used as an alternative to agricultural lime.

In addition to providing lime, soil fertility in acidic land can be increased by adding organic materials to increase the availability of nutrients, by giving organic fertilizers. Several organic fertilizers commonly used are cow manure, chicken manure and commercial compost. Cow manure contains nutrients N 0.10-0.96%; P<sub>2</sub>O<sub>5</sub> 0.64-1.15%; and K<sub>2</sub>O 0.45-1.00% (Sakti & Sugito, 2019). According to Susylowati et al. (2023), the nutrients contained in chicken manure are N 3.21%; P<sub>2</sub>O<sub>5</sub> 3.21%; and K<sub>2</sub>O 1.57%. The nutrients in commercial compost are N 1.68%; P<sub>2</sub>O<sub>5</sub> 7.99%; and K<sub>2</sub>O 1.41%.

The results of the study by Thivakaran et al. (2021) stated that providing a source of calcite from gypsum can increase the development of peanut pods at the flowering stage due to sufficient Ca in the plant's root area. According to the study by Fadil & Sutejo, (2020), organic chicken manure fertilizer provided the highest number of fruits and fruit weight per plant in eggplant, compared to compost and cow manure. This is because chicken manure fertilizer has more nutrients than other manure fertilizers. This is supported by the study by Andra & Made, (2022) that the provision of chicken manure fertilizer has the best effect on the growth and yield of peanut.

Based on the description above, it is necessary to research the combination of calcite sources and organic fertilizers to determine the effect on the growth and yield of peanut plants (*Arachis hypogaea* L.) on ultisol soil.

## 2. Material and Methods

This research was conducted in Mei - August 2024 at the UPTD Balai Benih Pertanian Air Pelempang, Air Buluh Village, Mendo Barat District, Bangka Regency, Bangka Belitung Province. The materials used were peanut seeds from BSIP, gypsum waste from the Unit Muntok Metalurgi, agricultural lime ( $\text{CaCO}_3$ ), commercial compost, chicken manure and cow manure. The research used a Split-Plot design was randomized with a RAK. The main plot is without calcite source (P1), agricultural calcite (P2) and gypsum waste (P3). The subplots are commercial compost (K1), chicken manure (K2) and cow manure (K3). There are 9 treatment combinations with 3 replications and 27 test units. Every unit test consists of 10 plants with 5 plant samples, so there is a population of 270 plants and 135 plant samples.

The study was conducted by making plot measuring 1 m x 0.8 m and then applying the treatment. The dose of liming application was 136 g/plot and organic fertilizer was as much as a dose of 1.2 kg/plot. Planting was done after the seeds were soaked for 15 minutes, then planted in a planting hole to a depth of 2-3 cm as much as one seed and covered with soil without being compacted. Plant maintenance involves watering, replanting, weeding, and controlling pests and diseases. Harvesting is done when the plants are 90-95 days old and have shown the criteria for being ready for harvest.

The parameters observed were plant height (cm), number of leaves (strands), flowering age (days), percentage of effective root nodules (%), wet weight of the crown (g), wet weight of the root (g), dry weight of the crown (g), dry weight of the root (g), root crown ratio, root length (cm), root volume (cm<sup>3</sup>), weight of complete pods (g), weight of empty pods (g), number of complete pods (pieces), number of empty pods (pieces), weight of seeds per plant (g) and weight of 100 seeds (g). Data analysis used an F test analysis of variance with a significant level of 95%, if there was a significant effect a further Duncan's Multiple Range Test (DMRT) test was used with a significant level of 95%.

## 3. Result

The analysis of variance (Table 1) showed an effect of the provision of calcite sources and organic fertilizers on the growth and yield of peanut in ultisol soil. The application of calcite sources had a very significant effect on the percentage of effective root nodules, weight of filled pods, weight of empty

Pods and total empty pods. Significantly affected the number of leaves, total filled pods and seed weight per plant, but it had no significant impact on other parameters. The treatment of organic fertilizer application showed a very significant effect on the parameters of plant height, number of leaves, percentage of effective root nodules, weight of filled pods, total filled pods, seed weight per plant, crown dry weight and root dry weight. It had a significant effect on the root volume parameter but no significant impact on other parameters. The interaction of the application of calcite sources and organic fertilizers showed a very significant impact on the parameters of plant height, number of leaves, percentage of effective root nodules, weight of filled pods, weight of empty pods, total filled pods, total empty pods and seed weight per plant. It had a significant effect on the parameter of dry root weight, but it had no significant impact on other parameters.

The average effect of calcite sources on the growth and yield of peanut (Table 2) showed that the highest number of leaves, weight of filled pods and total filled pods were found in the treatment of calcite sources from agricultural calcite, significantly different from the treatment of gypsum

waste and without calcite. The highest percentage of effective root nodules was found in the treatment of gypsum waste, significantly different from the treatment of agricultural calcite and without calcite. The highest weight weight of empty pods and total empty pods were found in the treatment without calcite, significantly different from the treatment of agricultural calcite and gypsum waste. The highest seed weight per plant was found in the treatment of agricultural calcite, it was not significantly different from the treatment of gypsum waste and significantly different from the treatment without calcite.

The average effect of organic fertilizer on the growth and yield of peanut (Table 3) showed the highest plant height and number of leaves in the chicken manure fertilizer treatment but not significantly different in cow manure fertilizer and significantly different in commercial compost. The parameters percentage of effective root nodule, root dry weight, weight of filled pods, total filled pods, seed weight per plant, dry crown weight, dry root weight, and root volume were highest in the chicken manure fertilizer treatment, significantly different in the cow manure fertilizer treatment and commercial compost.

Table 1 Results of the analysis of the variance of calcite sources and organic fertilizers on peanut parameters.

Parameter	Source Calcite		Fertilizer Organic		KK (%)	Interaction		
	F-hit	Pr>F	F-hit	Pr>F		F-hit	Pr>F	KK (%)
Plant Height (cm)	1.84 <sup>tn</sup>	0.200	12.91**	<0.01	10.06	4.62**	<0.01	9.06
Number of leaves (blades)	5.72*	0.018	12.78**	<0.01	7.13	4.71**	<0.01	7.05
Flowering Age (days)	2.28 <sup>tn</sup>	0.144	2.84 <sup>tn</sup>	0.097	3.85	2.06 <sup>tn</sup>	0.104	4.01
Effective Root Nodules (%)	35.97**	<0.01	14.61**	<0.01	3.13	17.30**	<0.01	2.77
Weight of Filled Pods (g)	8.48**	<0.01	24.42**	<0.01	11.02	5.17**	<0.01	14.14
Weight of Empty Pods (g)	31.10**	<0.01	1.34 <sup>tn</sup>	0.299	59.78	6.60**	<0.01	67.58
Total Filled Pods (pieces)	5.29*	0.022	49.47**	<0.01	11.48	8.71**	<0.01	14.36
Total Empty Pods (pieces)	30.15**	<0.01	1.89 <sup>tn</sup>	0.700	51.84	7.18**	<0.01	56.08
Weight Seed Plant (g)	5.01*	0.026	40.89**	<0.01	18.37	10.64**	<0.01	19.29
Crown Wet Weight (g)	1.94 <sup>tn</sup>	0.185	2.14 <sup>tn</sup>	0.160	27.05	1.49 <sup>tn</sup>	0.235	24.31
Crown Dry Weight (g)	1.41 <sup>tn</sup>	0.281	8.00**	<0.01	27.17	2.32 <sup>tn</sup>	0.072	27.79
Root Wet Weight (g)	2.55 <sup>tn</sup>	0.119	0.95 <sup>tn</sup>	0.414	10.68	0.94 <sup>tn</sup>	0.513	11.28
Root Dry Weight (g)	0.91 <sup>tn</sup>	0.427	7.73**	<0.01	16.93	3.31*	0.019	17.24
Root Length (g)	2.73 <sup>tn</sup>	0.105	1.91 <sup>tn</sup>	0.189	9.58	0.95 <sup>tn</sup>	0.503	10.69
Root Volume (cm <sup>3</sup> )	2.29 <sup>tn</sup>	0.143	6.75*	0.011	17.45	2.37 <sup>tn</sup>	0.067	17.68
Root Crown Ratio	0.28 <sup>tn</sup>	0.758	1.14 <sup>tn</sup>	0.353	33.71	0.70 <sup>tn</sup>	0.685	32.80
Weight of 100 Seeds (g)	1.99 <sup>tn</sup>	0.179	3.49 <sup>tn</sup>	0.064	8.89	1.26 <sup>tn</sup>	0.331	9.5

Description: F-hit = F-count, Pr>F = Probability value, KK = Coefficient of diversity, \*\* = Very significant effect, \* = Significant effect, tn = Not significant effect.

Table 2 Average effect of calcite sources on the growth and yield of peanut plants.

Parameter	Calcite Source		
	Without Calcite	Agriculture Calcite	Gypsum Waste
Plant Height (cm)	45.31	48.60	44.67
Number of leaves (blades)	191.95 b	214.00 a	197.70 b
Flowering Age (days)	27.88	28.88	28.00
Percentage of Effective Root Nodules (%)	81.69 c	88.46 b	92.55 a
Weight of Filled Pods (g)	57.61 b	71.06 a	62.40 b
Weight of Empty Pods (g)	2.24 a	0.28 b	0.42 b
Total Filled Pods (pieces)	48.83 b	57.62 a	50.88 b
Total Empty Pods (pieces)	6.93 a	1.02 b	2.03 b
Weight Seed Plant (g)	28.92 b	38.07 a	33.19 ab
Crown Wet Weight (g)	130.33	167.89	150.00
Crown Dry Weight (g)	31.60	39.24	36.14
Root Wet Weight (g)	11.27	12.63	11.93
Root Dry Weight (g)	1.97	2.20	2.12
Root Length (g)	30.33	33.66	32.57
Root Volume (cm <sup>3</sup> )	10.13	11.60	12.02
Root Crown Ratio	16.02	17.96	17.56
Weight of 100 Seeds (g)	36.25	39.33	38.47

Description: Numbers followed by the same letter in the same row indicate results that are not significantly different based on the DMRT test  $\alpha = 5\%$ .

Table 3 Average effect of organic fertilizer on the growth and yield of peanut plants.

Parameter	Organic fertilizer		
	Commercial Compost	Chicken Manure	Cow Manure
Plant Height (cm)	40.23 b	51.26 a	47.08 a
Number of leaves (blades)	183.34 b	217.42 a	202.89 a
Flowering Age (days)	28.88	28.22	27.66
Percentage of Effective Root Nodules (%)	84.91 b	91.55 a	86.27 b
Weight of Filled Pods (g)	51.30 b	74.23 a	65.54 b
Weight of Empty Pods (g)	1.15	0.72	1.07
Total Filled Pods (pieces)	36.64 c	63.60 a	57.08 b
Total Empty Pods (pieces)	4.08	2.51	3.39
Weight Seed Plant (g)	18.82 c	44.12 a	37.24 b
Crown Wet Weight (g)	130.56	169.89	147.78
Crown Dry Weight (g)	28.98 c	46.07 a	31.93 b
Root Wet Weight (g)	11.51	12.34	11.98
Root Dry Weight (g)	1.88 b	2.42 a	1.93 b
Root Length (g)	30.80	33.64	32.13
Root Volume (cm <sup>3</sup> )	9.82 b	13.13 a	10.80 b
Root Crown Ratio	15.45	19.42	16.63
Weight of 100 Seeds (g)	36.00	40.20	37.86

Description: Numbers followed by the same letter in the same row indicate results that are not significantly different based on the DMRT test  $\alpha = 5\%$ .

The interaction of calcite sources and organic fertilizers on the vegetative growth of peanut (Table 4) showed significant differences in the vegetative parameters of plant height and number of leaves but not significant differences in other vegetative parameters. The plant height parameter showed the highest value in the (P2K2) treatment, not significantly different in the (P1K2), (P1K3),

(P2K3), (P3K2), and (P3K3) treatments and significantly different in other treatments. The number of leaves showed the highest value in the (P2K2) treatment, which was not significantly different in the (P2K3) and (P3K2) treatment.

The interaction of calcite sources and organic fertilizers on peanut roots (Table 5) showed significant differences in root dry weight and

effective root nodule percentage but not significant differences in other parameters. Root dry weight showed the highest value in the (P3K2) treatment, not significantly different in (P2K2) and significantly different in other treatments. The percentage of effective root nodules showed the highest value in the (P3K2) treatment but not significantly different in the (P2K2), (P3K1), and (P3K3).

The interaction of calcite source and organic fertilizer on generative parameters of peanut (Table 6) showed significant differences in all parameters except flowering age and weight of 100 seeds. The weight of filled pods showed the highest value in the (P2K2) treatment and not significantly different in

the (P3K2) treatment. The weight of empty pods showed that the (P1K1), P(1K2), and (P1K3) treatments were not significantly different and significantly different in other treatments. The total filled pods showed the highest value in the (P2K2) treatment, was not significantly different in the (P1K2), (P2K3), (P3K2), and (P3K3) treatments, and was significantly different in other treatments. The total empty pods showed the highest value in the P1K1 treatment, was not significantly different in the (P1K3) treatment, and was significantly different in other treatments. The weight of seeds per plant showed the highest value in the (P2K2) treatment but not significantly different in the (P2K3) and (P3K2) treatments.

Table 4 Interaction of calcite sources and organic fertilizers on vegetative parameters of peanut plants.

Treatment	Parameter				
	Plant Height	Number of leaves	Crown Wet Weight	Crown Dry Weight	Root Crown Ratio
P1K1	39.86 cd	177.60 c	120.33	24.46	14.79
P1K2	49.60 ab	197.79 bc	135.67	42.68	20.17
P1K3	46.46 abc	200.47 bc	135.00	27.68	13.15
P2K1	43.06 bcd	189.51 bc	144.67	30.70	13.97
P2K2	53.93 a	236.71 a	204.33	49.18	21.08
P2K3	48.80 ab	215.47 ab	154.67	37.83	18.85
P3K1	37.76 d	182.91 c	126.67	31.78	17.61
P3K2	50.26 ab	217.77 ab	169.67	46.38	17.19
P3K3	46.00 abc	192.42 bc	153.67	30.28	17.89

Description: P1K1 = without calcite + commercial compost; P1K2 = without calcite + chicken manure; P1K3 = without calcite + cow manure; P2K1 = agricultural calcite + commercial compost; P2K2 = agricultural calcite + chicken manure; P2K3 = agricultural calcite + cow manure; P3K1 = gypsum waste + commercial compost; P3K2 = gypsum waste + chicken manure; P3K3 = gypsum waste + cow manure. Numbers followed by the same letter in the same column indicate results that are not significantly different based on the DMRT test  $\alpha = 5\%$ .

Table 5 Interaction of calcite sources and organic fertilizers on peanut root parameters.

Treatment	Parameter				
	Root Length	Root Wet Weight	Root Dry Weight	Root Volume	Percentage of Effective Root Nodules
P1K1	29.26	10.72	1.66 c	9.20	78.74 d
P1K2	31.46	11.48	2.18 bc	11.73	87.94 bc
P1K3	30.26	11.62	2.08 bc	9.46	78.40 d
P2K1	32.40	12.12	2.21 bc	10.13	84.64 c
P2K2	35.26	13.53	2.78 ab	13.00	91.89 ab
P2K3	33.33	12.25	2.00 bc	11.66	88.86 bc
P3K1	30.73	11.70	1.78 bc	10.13	91.34 ab
P3K2	34.20	12.07	2.88 a	14.66	94.76 a
P3K3	32.80	12.09	1.71 bc	11.27	91.56 ab

Description: P1K1 = without calcite + commercial compost; P1K2 = without calcite + chicken manure; P1K3 = without calcite + cow manure; P2K1 = agricultural calcite + commercial compost; P2K2 = agricultural calcite + chicken manure; P2K3 = agricultural calcite + cow manure; P3K1 = gypsum waste + commercial compost; P3K2 = gypsum waste + chicken manure; P3K3 = gypsum waste + cow manure. Numbers followed by the same letter in the same column indicate results that are not significantly different based on the DMRT test  $\alpha = 5\%$ .

Table 6 Interaction of calcite sources and organic fertilizers on generative parameters of peanut plants.

Treatment	Parameter						
	Flowering Age	Weight of Filled Pods	Weight of Empty Pods	Total Filled Pods	Total Empty Pods	Weight Seed Per plant	Weight of 100 Seeds
P1K1	28.00	44.92 d	2.72 a	33.87 d	8.73 a	17.38 d	33.90
P1K2	28.00	68.02 bc	1.70 a	59.06 ab	5.33 bc	37.79 b	37.83
P1K3	27.66	59.89 bcd	2.30 a	53.53 bc	6.73 ab	31.60 bc	37.03
P2K1	30.66	56.33 bcd	0.26 b	41.06 cd	1.20 d	20.96 cd	37.76
P2K2	28.33	85.06 a	0.08 b	70.80 a	0.26 d	50.93 a	41.53
P2K3	27.66	71.80 ab	0.49 b	61.66 ab	1.60 d	42.32 ab	38.70
P3K1	28.00	52.66 cd	0.46 b	35.00 d	2.33 cd	18.14 d	36.33
P3K2	28.33	69.60 abc	0.38 b	61.60 ab	1.93 cd	43.65 ab	41.23
P3K3	27.66	64.93 bc	0.43 b	56.06 ab	1.84 cd	37.79 b	37.86

Description: P1K1 = without calcite + commercial compost; P1K2 = without calcite + chicken manure; P1K3 = without calcite + cow manure; P2K1 = agricultural calcite + commercial compost; P2K2 = agricultural calcite + chicken manure; P2K3 = agricultural calcite + cow manure; P3K1 = gypsum waste + commercial compost; P3K2 = gypsum waste + chicken manure; P3K3 = gypsum waste + cow manure. (Numbers followed by the same letter in the same column indicate results that are not significantly different based on the DMRT test  $\alpha = 5\%$ ).

#### 4. Discussion

The results of the analysis of variance showed that the provision of calcite sources affected the parameters of the number of leaves, percentage of effective root nodules, weight of filled pods, weight of empty pods, total filled pods, total empty pods, and seed weight per plant. It is suspected that providing calcite sources can increase soil pH, improve the availability of Ca for plants, increase base saturation, and reduce Al-dd (Bachtiar et al., 2021). According to von Tucher et al. (2018), increasing soil pH plays a vital role in supporting the availability of soil nutrients for plants. The increased availability of Ca elements due to the provision of both calcite sources causes better generative growth because sufficient Ca elements can increase the formation and filling of pods optimally so that the filling of the pods is more perfect and produces higher seed yields (Samosir et al., 2023). The provision of organic fertilizers affects plant height, number of leaves, percentage of effective root nodules, weight of filled pods, total filled pods, seed weight per plant, dry weight of the crown, dry weight of the roots, and root volume. It is suspected that providing organic fertilizer can add essential nutrients and increase nutrient availability in the soil that plants need (Andra & Made, 2022).

The provision of calcite sources and organic fertilizers showed increased soil pH, although the increase was slightly acidic (Table 9). Providing agricultural calcite to the soil can precipitate  $Al^{3+}$  into  $Al(OH)_3$  so that Al is not active in increasing soil acidity (Dariah et al., 2015). This is supported by research by Amelia et al. (2018), who found that  $Al^{3+}$  will react with  $OH^-$ . From the reaction of lime materials to form  $Al(OH)_3$  deposits, at the same time, the soil pH will increase so that the absorption

of nutrients is not hampered by plants, which causes better plant growth and production. Research (Kurniawan et al., 2021) states that liming increases soil pH through  $H^+$  and  $Al^{3+}$  ions in the soil, which previously caused soil acidity, and replaces them with  $Ca^{2+}$  ions from calcite. Better soil conditions due to increased soil pH can increase the number of root nodules because the activity of Rhizobium bacteria that are symbiotic with peanut roots will develop more so that many effective root nodules are formed (Gunawan & Kartina, 2018).

The provision of calcite source from agricultural calcite showed the growth and yield of peanut in the parameters of the number of leaves, weight of filled pods, total filled pods, and weight of seeds per plant better than the treatment of gypsum waste and without calcite. It is suspected that the provision of agricultural calcite, in addition to being effective in increasing land fertility by increasing soil pH, also provides Mg elements not found in gypsum waste. Agricultural calcite has a low Mg content (<5%) (Dariah et al., 2015). The magnesium element is essential for forming chlorophyll, which is the main ingredient in the photosynthesis process of peanut (Setiono et al., 2018). This is supported by the statement of Marpaung (2018) that magnesium can increase leaf chlorophyll levels and maximize the filling of plant pods/seeds, the pods produced are fuller and more prominent so that plant yields will rise. In addition to being a source of Ca and little Mg nutrients, the provision of agricultural calcite can also increase the availability and absorption of elements such as N, P, and K. It can reduce the absorption of toxic heavy metals that are inhibitory to plants (Prihantoro et al., 2023).

The treatment of organic chicken manure fertilizer showed the best effect on the growth and yield of peanut compared to other organic fertilizers. This is because the provision of chicken manure fertilizer has a higher N content than other

fertilizers, so the vegetative and generative growth of plants is more optimal. Increasing the availability of N will result in more optimal photosynthesis activity so that the assimilates produced are more excellent, then translocated to all parts of the plant, such as the vegetative parts of the plant, and will be stored as food reserves in the form of carbohydrates in the form of seeds (Amir & Fauzy, 2018). This is supported by the results of research by Puspawati *et al.* (2016) that the provision of chicken manure fertilizer containing higher N elements can increase height growth, the number of leaves increases, and the leaves are broader, resulting in increased plant weight. Asis *et al.* (2022) stated that the N element, in addition to stimulating vegetative plant growth, also gives a green color to the leaves. Leaves that are darker green indicate the higher the N element absorbed by the plant (Yahmanto *et al.*, 2023). In addition to the N element, chicken manure fertilizer provides P and K elements, which are essential in forming pods and peanut plant seeds (Anwar *et al.*, 2022).

The combination of the agricultural calcite and chicken manure fertilizer (P2K2) interaction showed the highest results in all parameters except root dry weight, percentage of effective root nodules, and flowering age. This is because the provision of agricultural calcite, in addition to adding Ca nutrients, can also increase the availability of other nutrients due to increased soil pH (Simatupang *et al.*, 2023) so that plants can absorb nutrients from chicken manure fertilizer well, which causes increased growth and yield of peanut. According to Saputro, (2021), peanut requires sufficient quantities of elements such as N, P, K, and Ca to help form pods and seeds obtained through fertilization and liming. This is in accordance with the research of Siga & Bolly, (2019) which found that the provision of chicken manure significantly affects plant height, number of leaves, number of pods, and weight of peanut pods. Plants that receive a high supply of N from chicken manure fertilizer will form leaves with wider blades with higher chlorophyll content to produce carbohydrates/assimilates in sufficient quantities for vegetative growth and crop production (Marlina *et al.*, 2015).

The source of calcite from gypsum waste shows potential as an alternative substitute for agricultural calcite when combined with chicken manure fertilizer because it is not significantly different from agricultural calcite in all parameters (Tables 6, 7, and 8). It is suspected that the provision of gypsum can improve plant root development and cause a slight increase in soil pH (Jyothsna *et al.*, 2024), as well as being a source of

Ca and S nutrients for plants. The Ca element is essential for pod formation, so it is important to provide calcium around the plant, a lack of Ca causes many empty pods (Sukmana *et al.*, 2017). Rashmi *et al.* (2018) stated that the S element from gypsum is used for N fixation in plants, soil with suboptimal S levels will affect this process. In line with Becana *et al.* (2018), the S element helps the nitrogenase enzyme in the N fixation process, thereby increasing the number and quality of root nodules. According to Sari & Taryono, (2022) an increase will follow the number of root nodules in root dry weight.

## 5. Conclusion

Based on the research, it can be concluded that the source of calcite and organic fertilizers affect the growth and yield of peanut plants in ultisol soil. The source of calcite from agricultural calcite and organic fertilizer from chicken manure gave the best results on the development and yield of peanut in ultisol soil. The combination of agricultural calcite and chicken manure is the best treatment for the growth and yield of peanut plants in ultisol soil. The source of calcite from gypsum waste has the potential to be a substitute for agricultural calcite when combined with chicken manure fertilizer, as it does not have significant results with agricultural calcite.

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## 7. Declaration of Conflicting Interests

*The authors have declared no potential conflicts of interest concerning the study, authorship, and/or publication of this article.*

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