

The Effect of Phosphate Dosage on the Growth and Production of Peanut Plants

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ABSTRACT

Peanut is a food crop with economic value and high fat and protein content. This study aims to determine the effect of phosphate dose on the growth and production of peanuts. This study used a Randomized Block Design, with six treatments and four replications. One treatment consisted of 4 sample plants. The treatments used were as follows: A: 0 grams of TSP per plant (control); B= 0.22 grams of TSP per plant; C= 0.33 grams of TSP per plant; D= 0.44 gram TSP per plant; E= 0.55 grams of TSP per plant; F= 0.66 grams of TSP per plant. The parameters observed in this study were: plant height, number of branches, flowering age, percentage of filled pods, percentage of cipo pods, the weight of 100 seeds, and weight of seeds for each plant. Based on the results of the research that has been carried out, it is concluded that: Phosphate fertilizer affects the growth and production of kidang variety peanuts in the Lebak swamp land, meanwhile, treatment D, i.e. treatment with a phosphate dose of 0.44 grams of TSP per plant, was the best treatment.

Keywords: Phosphate, Dosage, Peanut

1. Introduction

Peanuts are a food crop with high economic value due to their nutritional content, particularly their high protein and fat content (Arianti et al., 2021). Peanut demand continues to increase annually in line with population growth, community nutritional needs, food diversification, and the increasing capacity of the Indonesian food and feed industry. However, domestic peanut production is insufficient to meet Indonesia's needs, which still requires import substitution.

Peanut production in Sumatra reached 12,074 tons in 2012, declining to 11,351 tons in 2013. This decrease in production was due to a decrease in harvested area of 1,066 hectares, a decrease of 0.34 kW/ha, or 2.81%. In 2014, it decreased again to 9,778 tons (Central Statistics Agency, 2015).

The application of biofertilizers in groundnut cultivation can supply essential nutrients such as nitrogen and/or phosphorus to plants without leaving chemical residues in the environment, while also enhancing the microbial population associated with plant roots (Bargaz et al., 2018) (Munyari et al., 2025). Biofertilizers are products that contain beneficial living microorganisms

capable of inhabiting the rhizosphere or plant tissues, where they enhance the availability and uptake of essential nutrients, thereby supporting and improving plant growth (Krska et al., 2022) (Asoegwu et al., 2020). Biofertilizers are available in various formulations, such as dry products and liquid suspensions, and can be applied through seed treatment or delivered via irrigation water (Amenaghawon et al., 2021) (Allouzi et al., 2022). To achieve high production, fertilizer is a crucial factor in advanced agricultural efforts. Fertilizer is needed to maintain soil fertility and reduce crop production costs by increasing yields per hectare.

One of the essential nutrients for peanut plants is phosphorus (P), which accelerates plant growth and increases grain production (El-All et al., 2024). P is found in the soil as mineral phosphate in the form of plant debris and organic matter. Peanut plants require essential nutrients such as N, P, and K for growth and production, particularly for flower, pod, and seed formation (Fitriana et al., 2015). P is the second primary nutrient after N, playing a role in soil metabolism and microbiological processes and is absolutely essential for both soil microbes and plants

(Gusmiatun et al., 2019) (Mohamed et al., 2024). Phosphate itself plays an active role in the generative phase, such as accelerating flowering and fruit ripening.

Tidal and swampy areas in South Sumatra currently and in the future play a significant role in the success of the rice self-sufficiency program. Additionally, non-rice crops (secondary crops and horticulture) have long been traditional commodities, significantly increasing farmers' incomes.

Based on field observations in the Ogan Ilir area of Inderalaya District, peanut production ranged from 7 to 10 pods per plant. This is thought to be due to the low soil fertility of these swampy areas and the presence of toxic compounds such as Al, Mn, and Fe, which can bind other nutrients such as N, P, K, and others.

The swampy areas of South Sumatra, despite challenges such as poor water management and low natural fertility, have the potential to develop various agricultural enterprises. Several efforts have been and are being undertaken to address these challenges, including the construction of primary and secondary canals, liming, fertilization, and pest and disease control.

Previous study further explained that peanuts require phosphate fertilization at a rate of 45 kg per hectare. This will stimulate pod growth, fill unfilled pods, and accelerate fruit maturity.

Based on the above description, fertilization plays a role in increasing the fertility of swampy soil. Therefore, further research is needed to investigate the effect of phosphate fertilization on peanut growth and production in swampy soil.

2. Methodology

The research was conducted over three months on the grounds of the University of Palembang, Jl. Dharmapala No. 1A, Palembang, from March 2025 to June 2025.

The materials and tools used in this study were peanut seeds, urea, KCl, TSP, CaO lime, manure, swamp soil, polybags, pesticides, hoes, saws, machetes, hammers, nails, thatch roofing, measuring tape, scales, sprayers, sieves, gelam wood, raffia rope, and stationery.

This study used a Randomized Block Design (RBD), with 6 treatments and 4 replications. Each treatment had 4 sample plants. The treatments used were as follows: A: 0 grams of TSP per plant (control); B = 0.22 grams of TSP

per plant; C = 0.33 grams of TSP per plant; D = 0.44 grams of TSP per plant; E = 0.55 grams of TSP per plant; F = 0.66 grams of TSP per plant.

2.1. Procedures

The procedures implemented in this research were as follows:

1. Prepare a 4 m x 6 m plot of land. Clear the land of vegetation using a hoe and machete, and construct a fence from thatch.
2. Prepare the substrate by taking the topsoil from the swamp and drying it. Next, sift the soil and apply lime at a dose of 13.5 grams per 10 kg of soil. The soil is placed in polybags and arranged according to the research chart.
3. Prepare the treatment, using TSP fertilizer, weighed according to the treatment. This is applied at planting by sprinkling it on the soil surface and watering it with water.
4. Planting is carried out simultaneously with the application of TSP fertilizer as a treatment, along with urea at a dose of 0.20 grams per plant and KCl at a dose of 0.19 grams per plant as a base fertilizer. After applying the fertilizer, cover it with soil and water it with water.
5. Maintenance, including watering in the morning and evening if there is no rain, weeding, and pest and disease control.

2.2. Parameters

1. Plant Height (cm)
Plant height was measured two weeks after planting, until flowering, at weekly intervals. Measurements were taken from the soil surface to the growing point.
2. Number of Branches
The number of branches was counted from all branches formed on the sample plants. Observations were made after harvest.
3. Flowering Age (days)
Flowering age was observed after 50 percent of the plant population for each treatment had flowered.
4. Percentage of Filled Pods
The percentage of filled pods was taken from each sample plant and calculated after harvest.
5. Percentage of Unfilled Pods
The percentage of unfilled pods was taken from each sample plant and calculated after harvest.
6. Weight of 100 Seeds

The weight of 100 seeds was taken from each sample plant and calculated after harvest.

7. Seed weight per plant

The seed weight per plant is measured based on the seed weight of each sample plant after harvest.

3. Results and Discussion

3.1. Effect of Variables

Based on observations in this study, it was found that the effect of phosphate dosage on plant height, number of branches, flowering time, percentage of filled pods, percentage of unfilled pods, weight per 100 seeds, and seed weight per plant were significantly different compared to the other treatments. The effect of phosphate dosage on plant height can be seen in Table 1.

1. Plant Height

The analysis of variance (ANOVA) results showed that treatment D was significantly different from the other treatments. The BNJ test showed

that treatment D was significantly different from treatments F, A, E, and B, and significantly different from treatment C.

2. Number of Branches

The analysis of variance (ANOVA) results showed that the treatments were not significantly different. However, tabulation showed that treatment D had the highest number of branches, with 7.31, and treatment A had the lowest number of branches, with 5.06.

3. Flowering Time

The analysis of variance (ANOVA) results showed that the treatments were not significantly different. However, tabulation showed that treatment D had the fastest flowering time, with 27 days, followed by treatments E, C, F, E, and A, each with 27.75 days; 28.00 days; 28.25 days; 28.75 days; and 29.50 days.

Table 1. Effect of phosphate dosage on plant height (cm)

Parameters	Average (cm)	BNJ	
		0.05=3.21	0.01 = 4.06
F	14.83	a	A
A	15.78	a	AB
E	16.20	ab	AB
B	17.35	ab	AB
C	19.26	b	BC
D	22.98	c	C

Note: Numbers followed by the same letter are not significantly different.

4. Percentage of Filled Pods (%)

The results of the analysis of variance showed that each treatment was significantly different from the other treatments. The BNJ test showed that treatment D was significantly different from

treatments F, A, E, and B, but not significantly different from treatment C. Table 2 shows the percentage of filled pods with various phosphate levels.

Table 2. Effect of phosphate levels on the percentage of filled pods.

Parameters	Average (cm)	BNJ	
		0.05=0.32	0.01 = 0.41
A	8.98	a	A

F	9.07	a	A
E	9.19	a	A
B	9.23	a	A
C	9.26	a	AB
D	9.66	b	B

Note: Numbers followed by the same letter are not significantly different.

5. Percentage of Cipo pods (%)

The results of the analysis of variance showed that the treatment was significantly different from the other treatments. The BNJ

test showed that treatment D was significantly different from treatments C, B, E, F, and A. Table 3 shows the effect of phosphate dosage on the percentage of Cipo pods.

Table 3. Effect of phosphate dosage on the percentage of filled pods.

Parameters	Average (cm)	BNJ	
		0.05=0.78	0.01 = 0.99
D	2.59	a	A
C	3.75	b	B
B	3.84	b	B
E	3.91	b	B
F	4.21	b	B
A	4.37	b	B

Note: Numbers followed by the same letter are not significantly different.

6. Weight of 100 seeds (grams)

The results of the analysis of variance showed that treatment D was significantly different from the other treatments. The BNJ test showed that treatment D was significantly different from treatments C, B, E, F, and A. Table 4 illustrates the effect of phosphate dosage on the weight of 100 seeds.

Table 4. Effect of phosphate dosage on the weight of 100 seeds

Parameters	Average (cm)	BNJ	
		0.05=6.15	0.01 = 7.77
A	38.05	a	A
F	40.35	a	A
E	42.23	a	A
B	50.38	b	B
C	51.00	b	B
D	61.41	c	C

Note: Numbers followed by the same letter are not significantly different.

7. Seed weight per plant (grams)

The results of the analysis of variance showed that each treatment was significantly different from the other treatments. The BNJ test showed that

treatment D was significantly different from treatments C, B, E, F, and A. The effect of phosphate dosage on seed weight per plant can be seen in Table 5.

Table 5. Effect of phosphate dosage on seed weight per plant

Parameters	Average (cm)	BNJ	
		0.05=19.46	0.01 = 24.59
A	43.79	a	A
F	51.55	a	A
E	56.21	a	A
B	60.94	a	A
C	62.34	a	A

Note: Numbers followed by the same letter are not significantly different.

The analysis of variance showed that the phosphate application on the growth and yield of the Kidang variety of peanuts in swampy areas significantly affected plant height, percentage of filled pods, percentage of unfilled pods, weight per 100 seeds, and weight of seeds per plant. The effect was insignificant on the number of branches and flowering time.

Changes in the number of branches and flowering time were insignificant, but tabulated differences were observed. Treatment D had the highest number of branches compared to the other treatments. For flowering time, treatment D had the fastest flowering compared to the other treatments. Treatment A also produced the lowest yields for both number of branches and flowering time.

Although TSP fertilizer is water-soluble, it is easily washed away by irrigation. This indicates that TSP fertilizer fails to meet the required P nutrient requirements during the plant's reproductive phase, such as the stem, and the remainder is stored as protein and carbohydrates.

Phosphate treatment significantly impacted plant height, the percentage of filled pods, the percentage of unfilled pods, and the weight of 100 seeds per plant. This is thought to be because phosphate is useful for plants in stimulating the growth of early roots, especially the roots of seeds and young plants. The faster the root growth, the more readily the plants absorb water and nutrients

available in the soil, resulting in better plant growth and a better response to photosynthesis. Consequently, the plants thrive and produce high yields (Faza et al., 2019).

This is because TSP fertilizer is slightly soluble in water, allowing it to provide more P nutrients to the culture medium to stimulate the initial growth of peanut plants. P taken up by the roots is used in plant metabolic processes such as photosynthesis. Adequate P leads to optimal photosynthesis. Some of the assimilates produced are used in the formation and construction of plant organs, while the remainder is stored as protein and carbohydrates.

Treatment D performed best compared to the other treatments. This is thought to be because the phosphate required by peanut plants is optimally available, resulting in good and fertile plant growth (Rizki et al., 2016). Phosphate can accelerate root growth, stimulate and strengthen plant growth, and increase grain production (Faza et al., 2019) (Fathi and Afra., 2023). Plant P uptake and utilization are crucial for crop yield (Afra and Mozafar, 2017). Phosphorus deficiency will result in a poor and stunted plant system, poor fruit formation, and reduced seed (fruit) yield (Malhotra et al., 2018). Phosphate (P) is needed by plants for new cell formation in growing tissues and stem strengthening (Rafique et al., 2020).

Furthermore, Arwansyah et al., 2019, stated that soil deficient in phosphorus will result

in poor plant growth. Visible symptoms include the leaves turning completely dark and often appearing shiny red. The edges of the leaves, branches, and stems develop a purplish-red color that gradually turns yellow. When the plant bears fruit, the fruit is stunted, ugly, and ripens quickly (Wijaya and Syawal, 2015). Phosphorus is an essential nutrient for supporting reproduction, and a deficiency in P inhibits flower and cob formation, and grain formation (Rahmawati et al., 2018).

4. Conclusions

The conclusions drawn from the research results are:

1. Phosphate fertilizer affects the growth and production of the Kidang variety of peanut plants in swampy areas.
2. Treatment D, with a phosphate dose of 0.44 grams of TSP per plant, was the best treatment.

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