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Increasing Growth and Yield of Peanuts with Various Types and Dosages of Organic Fertilizer in Dry Land

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ABSTRACT

Dry land is very potential to be developed into agricultural land, one of which is planting peanuts, although it has constraints such as low pH and low soil fertility. Efforts can be made to improve soil fertility by applying organic fertilizer. Organic fertilizers are expected to improve the soil's physical, chemical, and biological properties and provide nutrients that peanut plants need. This research aims to obtain the right organic fertilizer type and dosage to increase peanut production. This research was conducted in farmers' fields in Margo Bhakti Village, Block C unit II, Mesuji District, Ogan Komering Ilir Regency (OKI) from March to June 2021. The layout in the field used a factorial RAK design with 9 treatment combinations repeated 3 x. Type of Organic Fertilizer: cow manure organic fertilizer, chicken manure organic fertilizer, biofertilizer. Dosage of organic fertilizer: 200 kg/ha, 400 kg/ha, 600 kg/ha. The heaviest pod weight was achieved in the combination of biofertilizer treatment at the dosage of 400 kg/ha at 89.67 g/plant or 6.97 kg/plot and increased production by 109.31% when compared to cow manure organic fertilizer at the rate of 200 kg/ha.

Keywords: *Types of Organic fertilizer, Dosages of Organik fertilizer, peanut, dry land*

1. INTRODUCTION

Low organic matter is the cause of arid land (Shaw et al., 2010; Wijanarko et al., 2014). In fact, organic matter on arid land plays a significant role in enhancing the soil's chemical, physical, and biological properties. By forming chelates between organic acids and Al ions, the use of organic materials or organic fertilizers on arid land can reduce the concentration of Al in the soil solution, making the existing nutrients available to plants, including peanut plants.

Given its multipurpose function as a source of food, feed, and industrial raw materials, peanut is one of the most important commodities in Indonesia. It plays a vital role in the nation's economy. Protein, lipid, iron, vitamin A, vitamin B complex, phosphorus, vitamin E, vitamin K, lecithin, choline, and calcium are abundant in peanuts (Rahmiana & Ginting 2012; Respati et al. 2013). It determines the nutritional quality of peanut seeds with a high protein content and negatively correlates with the seed oil content and the percentage of oleate (Santosa 2010; Wang et al. 2016). Peanut seeds are composed of 40–48 percent oil, 25 percent protein, 18 percent carbohydrates, and complex B vitamins (Kumar et al., 2014; Santosa, 2010).

In South Sumatra, peanut production averaged 2021 tons in 2015, 2007 tons in 2016, 3113 tons in 2017, 2141 tons in 2018, and 5090 tons in 2019 (BPS Province of South Sumatra, 2020). Fluctuations in the average peanut yield were caused by insufficient fertilization; therefore, efforts are being made to increase peanut yield by applying inorganic or organic fertilizers.

The organic fertilizer (PO) given in this study was organic fertilizer (POKA) and cow manure (POKS) which had been composted beforehand as well as biological organic fertilizer (POH) which was enriched by Azospirillum bacteria and phosphate solubilizing bacteria. Organic fertilizers for chicken and cow manure can improve soil fertility such as loosening the soil so that the peanut ginophore can develop properly (Marlina et al., 2015: Hanafiah, 2010). Some advantages of cow dung manure are to improve soil structure and act as decomposer of organic matter by soil microorganisms. Among the types of manure, it is cow dung that has a high fibre content such as cellulose, this is evident from the measurement results of the parameter C/N ratio which is quite high > 40. Besides that, this fertilizer also contains macronutrients such as 0.5 N, 0.25 P2O5, 0.5% K2O with a water content of 0.5%, and also contains other essential micro elements (Parnata, 2010)

Several studies have demonstrated that organic chicken manure can increase peanut production (Marlina et al., 2015; Gusventi et al., 2021), that cow manure can also increase peanut production (Sibagariang, 2020), and that biological organic fertilizer 400 kg/day ha can increase the production of soybeans (Marlina and Gusmiatun, 2020), shallots (Marlina et al., 2018a), and rice (Marlina et al. This research aimed to determine the optimal type and quantity of organic fertilizer for boosting legume production.

2. MATERIAL AND METHODS

From March to June 2021, this study was conducted in the farmer's garden in Margo Bhakti Village Block C unit II, Mesuji District, Ogan Komering Ilir (OKI) Regency. The field layout employed a RAK Factorial design with nine treatment combinations repeated three times. Types of organic fertilizer include cow manure, poultry manure, and biological organic fertilizer. 2. Organic fertilizer dosage: 200 kg/ha, 400 kg/ha, 600 kg/ha.

Organic fertilizer for cows and poultry is produced using the following ratio: Rice straw: EM-4 (20 kg: 1 kg: 20 ml) were mingled and fermented for 30 days while being stirred every five days. Biological organic fertilizer is composed of rice straw in the proportions of Manure chicken manure: Azospirillum bacteria and phosphate solubilizing bacteria (12 kg:8kg:20 ml) and fermented for 30 days with 5 days of agitating once; after 30 days, the bacteria are administered in a zigzag pattern.

The soil is tilled twice until it becomes looser, thereby completing soil processing. Then, create a 2 x 2 m map with a 50 cm distance between panels and a 1 m distance between replicates.

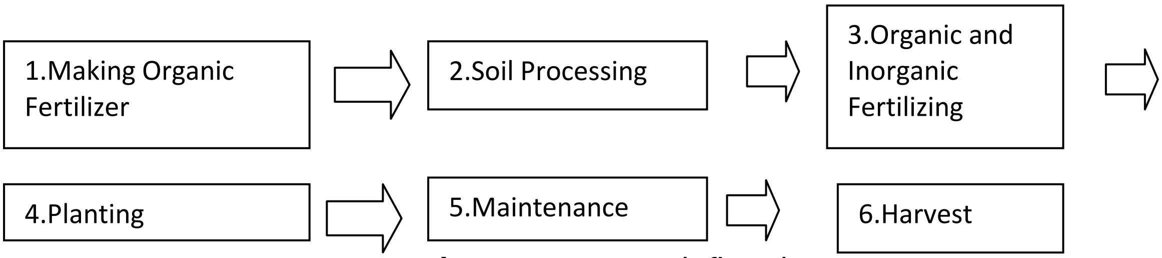

Figure 1. Research flowchart

The application of organic fertilizers occurs the day before sowing. Inorganic fertilizers such as urea, SP-36, and KCl are applied at planting at one-half the recommended rate (45 kg urea/ha, 45 kg SP-36/ha, and 25 kg KCl/ha). However, urea fertilizer is applied twice, once at planting and once at 30 HST.

One or two seeds are inserted into a 3-centimeter-deep planting hole and covered with a thin layer of earth. The spacing was 20 cm x 20 cm, and there were 81 plants and 10 sample plants per plot, totalling 81 plants.

Unless it rains, plants must be watered twice daily, in the morning and evening, unless it is raining. After 5-7 days, weeding is performed manually and routinely when weeds are observed. When the gynophore appears, the plant collects soil around its roots and hoards it.

3. RESULT AND DISCUSSION

The results demonstrated that the effect of the type and dosage of organic fertilizer independently had a highly significant effect on all observed variables, whereas the impact of their interaction had no significant effect. The BNT test was then conducted (Tables 2 and 3). On the variables of plant height, number of primary branches, number of filled pods per plant, pod weight per plant and plot, and approximate dried weight, biological organic fertilizers significantly differed from the use of cow dung organic fertilizer. The effects of 400 kg/ha of organic fertilizer on peanut growth and yield were substantially different from those of 200 kg/ha and 600 kg/ha (Table 2). While the combination of biological organic fertilizers at a dose of 400 kg/ha increased pod weight per plant by 97.82% and plot weight by 109.31% (Table 3).

Table 1. Results of the analysis of the diversity of types and doses of organic fertilizer on the observed variables

Observed Variables	Treatment			Coefficient of Diversity
	OF Type	OF Dose	Interaction	
Plant Height (cm)	18,82**	18,86**	0,24tn	5,10
Number of Primary Branches (branches)	48,80**	25,00**	0,44tn	5,21
The number of filled pods per plant	21,98**	9,80**	0,81tn	9,31
Pod weight per plant (g)	200,10**	30,15**	2,34tn	1,83
Pod weight per plot (kg)	215,16**	32,13**	2,64tn	2,36
Approximate Dry Weight (g)	67,14**	32,31**	0,90tn	6,45

Note: ** = very significant effect, tn = not significant effect

Table 2. Independent effect of type and dose of organic fertilizer on the observed variables

Treatment	Plant Height (cm)	Number of Primary Branches (branches)	The number of filled pods per plant	Pod weight per plant (g)	Pod weight per plot (kg)	Approximate Dry Weight (g)
------------- Types of organic fertilizers -----------------						
POKS	29,29 a	5,14 a	10,14 a	54,22 a	4,08 a	15,43 a
POKA	32,73 b	5,55 b	12,64 b	71,78 b	5,53 b	16,82 b
POH	34,33 b	6,56 b	13,89 c	79,22 c	6,12 c	21,67 c
BNT 0,05=	1,67	0,30	0,30	1,13	0,12	1,16
------------- Organic Fertilizer Dosage (kg/ha) -----------------						
200	29,78 a	5,22 a	11,33 a	57,13 a	4,42 a	16,33 a
400	34,56 c	6,22 c	13,56 b	79,00 c	6,07 c	20,44 c
600	32,78 b	5,89 b	12,33 a	68,89 b	5,22 b	17,56 b
BNT 0,05=	1,67	0,30	1,13	1,25	0,12	1,16

Note: The same notation in the same column means significantly different at the BNT level of 5%

Table 3. Effect of treatment combinations on pod weight per plant and per plot

Combination	Pod weight per plant (g)	Increase in percent (%)	Pod weight per plot (kg)	Increase in percent (%)
POKS+200 kg	45,33	-	3,33	-
POKS+400 kg	65,67	44,87	4,90	47,15
POKS+600 kg	51,67	13,99	4,00	20,12
POKA+200 kg	60,33	33,75	4,60	38,14
POKA+400 kg	81,67	80,17	6,33	90,09
POKA+600 kg	73,33	61,77	5,60	68,17
POH+200 kg	66,33	46,33	5,33	60,06
POH+400 kg	89,67	97,82	6,97	109,31
POH+600 kg	81,67	80,17	6,07	82,28

1. Plant Height

Biological organic fertilizers can increase plant height by 17.21% and 4.89 %, respectively, compared to manure from cows and chickens. The increase in plant height is inextricable from the availability of nitrogen by 1.70 percent due to the contribution of organic biological fertilizers. Plants consume the available N nutrients to produce chlorophyll, which significantly impacts photosynthesis. The results of photosynthesis will influence the plant's height and branching structure. While the use of organic cow dung fertilizer results in the lowest plant height, this is because organic cow dung fertilizer is unable to adequately enhance the physical, chemical, and biological properties of the soil, and its NPK nutrient supply is inferior to that of biological organic fertilizers. Improved suboptimal structuring will inhibit root growth because the roots will not penetrate the soil, resulting in poor nutrient assimilation and a deficiency of NPK nutrients in peanut plants. If these nutrients are lacking, the growth process, such as plant height, will be disrupted. According to Sugito (2012), a nitrogen deficiency in plants can result in pale green or yellow leaves (chlorosis) due to a low production of chlorophyll, essential for photosynthesis. Consequently, photosynthesis is inhibited and plant growth (such as plant height and number of branches) is stunted.

400 kg/ha of organic fertilizer can increase plant height by 16.05 percent when compared to 200 kg/ha of organic fertilizer. This indicates that the 400 kg/ha dose of organic fertilizer improved the soil's physical, chemical, and biological properties. Applying organic fertilizer loosens the soil physically, allowing the roots to flourish and absorb the decomposed nutrients. Soil with a loose structure and excellent drainage allows plants to absorb water, nitrogen, carbon dioxide, and oxygen more readily. According to Agustina (2015), peanuts prefer soil with a crumbly soil structure and excellent drainage so that plants can absorb water, nitrogen nutrients, CO2 and O2 more readily. Inadequate drainage inhibits root development, and nitrogen-fixing bacteria become inactive. The success of seed germination is increased in soil with a crumb structure, gynophore is easier to penetrate and develop into pods, and pods are simpler to remove at harvest time.

The combination of 400 kg/ha of biological organic fertilizers has been able to increase plant height. This indicates that biological organic fertilizers at a dose of 400 kg/ha could contribute N nutrients through the activity of *Azospirilium bacteria*.

2. Number of Primary Branches (branches)

The use of 400 kg ha1 of biological organic fertilizers increases the number of primary branches. An increase in the number of primary branches will increase the number of nodes, generating a gynophore that will elongate and carry the fruit containing seeds and embryos into the soil, ultimately leading to a rise in the number of pods per plant. According to Samosir et al. (2019), the weight of the pods per plant is determined by the number of filled pods per plant and the weight of the seeds. Photosynthetic activity is closely related to pod filling rate. The rate of photosynthesis is determined by chlorophyll and the nutrients P and K to a great extent. In addition, the outcomes of photosynthesis will be transferred to the embryos.

3. Number of Filled Pods per Plant (pods)

At a 400 kg/ha dose, biological organic fertilizer can increase the number of filled pods per plant. This is due to the activity of Azospirilium bacteria and phosphate solubilizing bacteria present in biological organic fertilizers. With the aid of nitrogenase enzymes found in their cell membranes, Azospirilium bacteria can fix N from the air and convert it into NH4+, making it accessible to plants. With the aid of phosphatase enzymes, phosphate-solubilizing microbes are able to provide P nutrients in the form of H2PO4-. This is supported by the fact that Azospirillum and Azotobacter can fix nitrogen asexually in rice, maize, sugarcane, and plantation crops (Mazid & Khan, 2015). Followed by Mohamed & Almaroai, 2016; Subedi, Khanal, Aryal, Chherti & Kandel, 2019) that Azospirillum and Azotobacter can increase the availability of N, reduce the use of chemical fertilizers, and generate phytohormones and exopolysaccharides. The available N and P nutrients will participate in photosynthesis and are incredibly beneficial for peanut plant pod formation.

According to Rawat et al. (2020), phosphate solubilizing bacteria can dissolve phosphate that does not dissolve in soil through mechanisms such as organic acid secretion, enzyme production, and excretion of siderophores that chelate metal ions and form complexes, making phosphate available for plant uptake. In addition, by producing plant growth-promoting hormones such as auxin, gibberellins, and cytokinins, antibiosis against pathogens, and 1-aminocyclopropyl-1-carboxylic acid deaminase, these bacteria promote plant growth and yields. These hormones promote plant growth under stressful conditions, enhance plant resistance to heavy metal toxicity, etc. Pyrroloquinoline quinine (pqq) and glucose dehydrogenase (gcd) are representative genes for phosphorus solubilization in bacteria.

4. Pod Weight per Plant and per Plot

The combination of biological organic fertilizer at 400 kg/ha increased pod weight per plant and per plot by 97.82% and 109.31%, respectively, when compared to the combination of organic cow manure fertilizer at 200 kg/ha. This is firmly supported by the results of an analysis of the biological organic fertilizers used, which contained 1.70 percent nitrogen, 2.57 percent phosphorus, 3.63 percent potassium, and a C/N ratio of 14.08. It differs from organic bovine dung fertilizer, which contains 0.5 nitrogen, 0.25 phosphorus, and 0.5 potassium. This C/N ratio of 14.08 indicates that the organic fertilizer has been properly decomposed with the aid of Azospirillum bacteria and phosphate solubilizing bacteria so that the peanut plants have sufficient nutrients, so that the plants' nutrient requirements are met, and so that the plants' growth and yield can be increased.

The availability of N, P, and K nutrients has allowed peanut plants to increase pod weight per plant and plot. The nutrient element phosphorus plays a crucial role in the formation of ATP, which is essential for energy transfer, as well as phospholipids and nucleic acids, which are the building blocks of DNA and RNA. This indicates that phosphorus plays a greater function during the phase of reproduction. The availability of sufficient P nutrients for plants will influence vegetative growth, such as the number of branches, as well as increase

photosynthetic activity and carbohydrate content in the receptacles of seeds (Yasinta et al., 2017).
According to Subandi (2013), the function of K can stimulate carbohydrate and protein metabolism enzyme activity. The conversion of solar energy to chemical energy (ATP or organic compounds) is greatly aided by sufficient potassium. A strong correlation exists between K levels in plant tissues and CO2 assimilation. If a plant is deficient in potassium, carbohydrates' transport (translocation) from the foliage to other organs is inhibited, causing photosynthetic products to accumulate in the leaves and slowing photosynthesis..

This is because the combination of organic bovine dung fertilizer at a dose of 200 kg/ha can reduce the growth and yield of peanut plants. According to Wiraatmaja (2017), if plants are deprived of the necessary nutrients, their growth and development will be aberrant.

According to Sugito (2012), insufficient chlorophyll production can result in chlorosis (pale green or yellow leaves) in plants lacking nitrogen. In the meantime, chlorophyll is essential to the process of photosynthesis. Without chlorophyll, the process of photosynthesis is hindered, and growth (such as plant height and number of leaves) and yield (number and weight of filled pods per plant) are diminished.

According to Subandi (2013), phosphorus deficiency in plants results in stunted or stunted growth and dark green leaves; plants do not produce flowers and fruit; if they have already produced fruit, it is small, ugly, and ripens rapidly. K deficiency will also impede the opening and closing of stomata, thereby disrupting photosynthetic activity due to diminished CO2 entrance into the leaves.

4. CONCLUSION

The combination of biological organic fertilizer treatment with a dose of 400 kg/ha of 89.67 g/plant or 6.97 kg/plot and an increase in yield by 109.31% resulted in the heaviest pod weight. in contrast to bovine manure organic fertilizer applied at a rate of 200 kilograms per hectare.

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