Effectiveness of Liquid Organic Fertilizer On N-Total of Soil, N, P, K Uptake, and Yields of Peanut (*Arachis hypogaea* L.) In Inceptisols Jatinangor

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Abstract. Inceptisols are often used for intensive cultivation and have low levels of essential nutrients. Improvement of this fertility rate can be achieved by the application of organic based fertilizers that can increase soil fertility. Peanut has long been cultivated in Indonesia and is generally grown on dry land. This research was conducted from February to June 2023, at the experimental garden, Padjadjaran University. This research aims to determine the effect of liquid organic fertilizer combined with standard NPK fertilizer on soil N total, plant nutrient uptake, and peanut yields in Inceptisol Jatinangor. This study used a randomized block design experimental method with nine treatments and three replications, and the amount is 27 experimental units. The result shows that the combination of liquid organic fertilizer with NPK fertilizer can enhance yields of peanuts. The combination of 10 liters of liquid organic fertilizer per hectare andb ¾ dose of Urea, TSP and KCl can increase the total-N content of the soil, the absorption of N, P, and K, as well as the weight of dried pods. Therefore, the use of liquid organic fertilizer in peanut cultivation can be reduced by up to 25% and can increase the yield of peanut pods.

1 Introduction

Inceptisols are one of the largest widespread agricultural lands in Indonesia, covering approximately 70.52 million ha (37.5%) of Indonesia's land area. Inceptisols are often used for intensive cultivation, but due to improper management, the fertility rate is reduced. Because it lacks typical soil physical and chemical properties, this type of soil has a wide range of natural productivity. Inceptisol utilization must be maximized in the future, particularly for those that have undergone intensive soil management. Inceptisols have under level of the essential nutrient mostly nitrogen (N), phosphorus (P), and potassium (K), so they need additional nutrients [1]. The soil orders that always found at the low land requirement with high input and inorganic input (the N,P,K, fertilizer) and also the organic inputs (implementation of whether manure or green manure) [2]. The sustainable

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implementation of the inorganic fertilizers excessively or at the upper doses without any return of organic fertilizer is thought to trigger a decrease in land productivity and a reduction in soil organic matter. The impact is that plant nutrient requirements are increasingly higher and must be met for optimal plant growth and yield [3]. To surmount the decreasing extent of the soil fertilitas and productivity, the suggestion is about to apply the fertilizer at the amalganated manner that combine the inorganic fertilizer with organic fertilizer.

Peanut (*Arachis hypogaea* (L.) Merr.) has long been cultivated in Indonesia and is generally grown on dry land. Indonesia is the tenth largest peanut producer in 2020, with peanut production reaching 860,000 tons [4]. One of effort that can be made to increase the results of broad associations is by improving cultivation techniques. The cultivation technique is the improvement of land management techniques and proper fertilization, both for organic and inorganic fertilizers, so that nutrients for plants will be available [5].

This research aims to specify the impact of liquid organic fertilizer combined with the standard N, P, and K on the soil N total, plant nutrient uptake, and peanut (*Arachis hypogaea* L.) yields in Inceptisol Jatinangor soil. This research is expected to provide useful information for farmers and entrepreneurs in the food sector, especially peanut farmers, so that they can increase their productivity.

2 Material and Methods

2.1 Research Location

The experiment is taken out at the experimental garden of the Faculty of Agriculture in Padjadjaran University on Inceptisol Jatinangor soil in latitude of 794m above the sea level and in the Plant Nutrition Laboratory of the Faculty of Agriculture in Padjadjaran University. According to the Oldeman climate classification, the experimental site's climate type is C2, with a wet month period of 5-6 months and an average rainfall of 2263.6 mm per year.

2.2 Materials and Tools

The materials used consisted of peanut seeds of the Garuda variety, Inceptisols Jatinangor soil media, liquid organic fertilizer (LOF), urea fertilizer, TSP fertilizer, KCl fertilizer, and materials used in laboratory analysis. The tools used in this study were polybags, markers, label paper, rulers, and laboratory equipment for analysis of N-total soil, and N, P, K uptake.

2.3 Methods

Table 1. Treatment Design

Code	Treatment	Liquid Organic Fertilizer (LOF) ($L.ha^{-1}$)	Dosage of NPK ($kg.ha^{-1}$)		
			Urea	TSP	KCl
A	Control	0	0	0	0
B	NPK Standard	0	50	100	50
C	½ dosage LOF + ¾ dosage NPK	5.00	37.5	75	37.5
D	¾ dosage LOF + ¾ dosage NPK	7.50	37.5	75	37.5
E	1 dosage LOF + ¾ dosage NPK	10.00	37.5	75	37.5
F	1 ½ dosage LOF + ¾ dosage NPK	15.00	37.5	75	37.5
G	¾ dosage LOF + 1 dosage NPK	7.50	50	100	50
H	1 dosage LOF + 1 dosage NPK	10.00	50	100	50
I	1 ½ dosage LOF + 1 dosage NPK	15.00	50	100	50

This study used an experimental method that arranged in randomized block design (RBD). The treatment was nine treatments and repeated three times which consists of one treatment as control, one treatment as recommendation fertilizer, and seven treatments as combination between liquid organic fertilizer and recommendation fertilizer. The research was conducted in several stages: soil preparation, fertilization and planting, maintenance, observation, sampling of soil and plants, and harvesting.

3 Results and Discussion

3.1 Soil Analysis Result Before Application

The soil analysis results show that the pH H_2O is slightly acidic (5.76). The soil pH determines the availability of nutrients for plants to absorb. Generally, nutrients are readily absorbed at a neutral pH (6-7), as at this pH, some of the nutrients are easily soluble in water. The soil has a low organic C content of 1.93%, a low total N content of 0.19%, and a low C/N ratio of 10. The soil's P_2O_5 HCl 25% content is high, at 52.43 mg.100g^{-1}, and the K_2O HCl 25% content is also high, at 49.14 mg.100g^{-1}.

3.2 Total Nitrogen

The statistical test result here found about the implementation of the LOF had no impact to the N total in soil. As maintained in Table 2 shows that the values in each treatment were relatively similar. This is in line with [6] who stated that urea would be more quickly available to plants and could also be easily lost due to evaporation and leaching, while N itself is mobile. The type of illite soil mineral in Inceptisols becomes a factor influencing the loss of soil N nutrients. Based on the initial soil analysis results, the soil Cation Exchange Capacity (CEC) content was 24.17 cmol.kg^{-1}. This CEC content falls into the illite clay mineral category of 10-40 cmol.kg^{-1}[7]. Illite clay minerals belong to the type 2:1 clay mineral, which have expansive and shrinkage properties depending on the condition of the soil (wet or dry). Dry soil can create cracks on the soil surface that can make soil N nutrients easily leached [8].

3.3 N, P, and K Uptake

Macro nutrients are essential as one of the supporting factors for plants to grow and develop well. The content of plant nutrients can be seen above. Based on the results of N, P, and K uptake analysis, it can be seen that the addition of liquid organic fertilizer dosage generally increases the content of N, P, and K in plant tissues (Table 2). In general, treatment A (control) had the lowest N, P, and K uptake values among the other treatments. Differences in uptake values began to appear in treatment NPK standard up to treatment 1 ½ dosage LOF + 1 dosage NPK. In terms of N uptake, treatment 1 dosage LOF + ¾ dosage NPK, treatment 1 ½ dosage LOF + ¾ dosage NPK, treatment ¾ dosage LOF + 1 dosage NPK, treatment 1 dosage LOF + 1 dosage NPK and treatment 1 ½ dosage LOF + 1 dosage NPK were higher than other treatments. In terms of P uptake, treatment 1 dosage LOF + ¾ dosage NPK, treatment 1 ½ dosage LOF + ¾ dosage NPK, and treatment 1 ½ dosages of test fertilizer + 1 standard fertilizer) were higher than other treatments. Meanwhile, in terms of K uptake, treatment 1 dosage of test fertilizer + 1 standard fertilizer was higher than other treatments. Among all treatments that had the best uptake values, it appears that a dosage of 1 until 1 ½ dosages of test fertilizer + ¾ dosage NPK standard fertilizer provides the highest results.

The availability of nutrients in the soil influences plant nutrient uptake [6]. Soil and organic material were the sources of nutrition for plants [9,10]. Where the process of releasing nutrients into the soil as additional nutrients such as macro nutrients require the decomposition of organic waste previously [11]. Beside that, where the suitability of the land for certain types of plants is concerned, the amount of soil fertility utilized as a medium for growing plants becomes important [12].

Table 2. The Effect of Liquid Organic Fertilizer and NPK fertilizer on Total N and Nutrient Uptake In Inceptisols Jatinangor

Treatment	Total N (%)	N-Uptake (%)	P-Uptake (%)	K-Uptake (%)
Control	0.12 a	1.53 a	0.25 a	0.82 a
NPK Standard	0.17 b	3.84 cd	0.37 bc	1.67 c
½ dosage LOF + ¾ dosage NPK	0.16 b	3.24 b	0.30 ab	1.45 b
¾ dosage LOF + ¾ dosage NPK	0.16 b	3.39 b	0.36 b	1.50 b
1 dosage LOF + ¾ dosage NPK	0.17 b	3.97 d	0.43 d	1.71 cd
1 ½ dosage LOF + ¾ dosage NPK	0.17 b	4.03 d	0.45 d	1.66 c
¾ dosage LOF + 1 dosage NPK	0.17 b	4.05 d	0.41 cd	1.77 cd
1 dosage LOF + 1 dosage NPK	0.18 b	3.98 d	0.40 cd	1.81 d
1 ½ dosage LOF + 1 dosage NPK	0.18 b	4.05 d	0.44 d	1.77 cd

3.4 Dry Weight of Pods per Plant

As maintained at the yield component data at Table 3 shows that different doses of liquid organic fertilizer in each treatment provide different results in terms of dry pod weight per plant. In terms of the parameter of dry pod weight per plant, treatment 1 dosage LOF + ¾ dosage NPK proved the highest value opposed to other treatment. The implementation of the organic fertilizer to the peanut plants may intensify the microbe content and nutrient in the soil, thus improving the growth and quality of peanut plants. Organic fertilizer can also enhance plant productivity, specifically by helping to increase the weight of dried peanut pods. Therefore, the regular application of organic fertilizer can have a positive effect on the increase of dry weight of pods.

The nutrients in organic materials can increase the weight of pods in soil. The implementation of the organic materials can also intensify the availability of water in the soil, thereby improving the production of peanut plants, especially during seed filling. Water plays a role in the translocation of organic compounds from leaves to seeds in the pods [13]. Liquid organic fertilizer contains essential macro nutrients N, P, and K, as well as micronutrients Fe, Zn, Cu, Mn, and B. Nitrogen is important for the formation of chlorophyll, which is involved in the process of photosynthesis. Phosphorus plays a role in enzyme reactions, such as phosphorylase at the mechanism of photosynthesis. Phosphorus plags a role in enzyme reactions at plants. Potassium existed as a main thing at the opening and closing of stomata, that related to the absorption of CO_2, so that the process of photosynthesis and other metabolic processes can proceed well [14]. According to Purbajanti et al.,[15], Fadhlina et al.,[16], and Belen Martinez et al. [17], stated that the sufficiency of macro and micro nutrients will increase the growth of plant.

Table 3. The Effect of Liquid Organic Fertilizer and NPK fertilizer on Yield of Peanut In Inceptisols Jatinangor

Treatment	Dry Weight od Pods per Plant (g)
Control	21,62 a
NPK Standard	33,06 b
½ dosage LOF + ¾ dosage NPK	34,40 b
¾ dosage LOF + ¾ dosage NPK	38,30 c
1 dosage LOF + ¾ dosage NPK	42,98 d
1 ½ dosage LOF + ¾ dosage NPK	40,36 cd
¾ dosage LOF + 1 dosage NPK	38,77 c
1 dosage LOF + 1 dosage NPK	40,72 cd
1 ½ dosage LOF + 1 dosage NPK	40,00 cd

4 Conclusion

The implementation of the liquid organic fertilizer plays an important role in the availability of nutrient elements needed by soil-grown peanut plants. A compound of the liquid organic fertilizer and the NPK can enhance different yields compared to the control. The combination of 10 liters of liquid organic fertilizer per hectare and ¾ dose of Urea, TSP and KCl could intensify the sum of N content at soil, the absorption of N, P, and K, as well as the weight of dried pods. Therefore, the use of liquid organic fertilizer in peanut cultivation can be reduced by up to 25% and can increase the yield of peanut pods.

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