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FERTILIZER APPLICATION ORGANIC LIQUID (LOF) NASA AND BIOCOMPOST ON THE GROWTH AND YIELD OF EDAMAME SOYBEAN PLANTS (*Glycine max* (L.) Merr)

APLIKASI PUPUK ORGANIK CAIR (POC) NASA DAN BIOKOMPOS TERHADAP PERTUMBUHAN DAN HASIL TANAMAN KACANG KEDELAI EDAMAME (*Glycine max* (L.) Merr)

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Abstract

This research was conducted to evaluate the influence of NASA LOF and biocompost on the growth performance of edamame soybean (*Glycine max* (L.) Merr.). The experiment employed a 4×4 factorial Randomized Block Design, where the first factor consisted of four concentrations of NASA LOF (P0 = control, P_1 = 5 ml/L per polybag, P_2 = 10 ml/L per polybag, and P_3 = 15 ml/L per polybag). In contrast, the second factor involved four levels of biocompost application (B_0 = control, B_1 = 50 g/polybag, B_2 = 100 g/polybag, and B_3 = 150 g/polybag). The results indicated that varying concentrations of NASA LOF (P_1, P_2, and P_3) did not produce significant differences in plant height at 14 DAP, and no significant variation was observed among the LOF treatments. The greatest number of pods per plant was recorded in the control treatment (P_0), which was statistically comparable to the P_2 treatment. Similarly, the highest pod weight per plant was obtained under the control treatment and did not differ significantly from P_2. Biocompost application significantly influenced plant height at 14 DAP; however, its effect was not significant at 28 and 42 days after planting for all dosage levels. The highest pod number was observed in the B_3 treatment (150 g/polybag), although it was not statistically different from the B_0, B_1, and B_2 treatments. In contrast, Pods weight per plant was not significantly affected by biocompost application at any dosage level.

Keywords*: soybean. edamame, NASA liquid organic fertilizer, biocompost*

Abstrak

Penelitian ini dilakukan untuk mengevaluasi pengaruh POC NASA dan biokompos terhadap kinerja pertumbuhan kedelai edamame (*Glycine max* (L.) Merr.). Percobaan memakai Rancangan Acak Kelompok Faktorial 4×4, di mana faktor pertama terdiri dari empat konsentrasi POC NASA (P_0 = kontrol, P_1 = 5 ml/L per p.bag, P_2 = 10 ml/L per p.bag, dan P_3 = 15 ml/L per p.bag), sedangkan faktor kedua melibatkan empat tingkat aplikasi biokompos (B_0 = kontrol, B_1 = 50 g/p.bag, B_2 = 100 g/p.bag, dan B_3 = 150 g/p.bag). Hasil penelitian menunjukkan bahwa variasi konsentrasi NASA LOF (P_1, P_2, dan P_3) tidak menghasilkan perbedaan signifikan pada tinggi tanaman pada 14 DAP, dan tidak ada variasi signifikan yang diamati di antara semua perlakuan penggunaan POC Jumlah polong terbanyak per tanaman tercatat pada perlakuan kontrol (P_0), yang secara statistik sebanding dengan perlakuan P_2. Demikian pula, berat polong tertinggi per tanaman diperoleh pada perlakuan kontrol dan tidak berbeda secara signifikan dari P_2. Aplikasi biokompos secara signifikan memengaruhi tinggi tanaman pada 14

HST; namun, pengaruhnya tidak signifikan pada 28 dan 42 hari setelah tanam untuk semua tingkat dosis. Jumlah polong tertinggi diamati pada perlakuan B3 (150 g/p,bag), meskipun secara statistik tidak berbeda dari perlakuan B_0, B_1, dan B2. Sebaliknya, berat polong per tanaman tidak dipengaruhi secara signifikan oleh aplikasi biokompos pada tingkat dosis apa pun.

Kata kunci: kedelai, edamame, pupuk organik cair NASA, biokompos

INTRODUCTION

Edamame (*Glycine max* (L.) Merr.) is a vegetable-type soybean widely consumed for its high nutritional value, particularly its protein content. In tropical agricultural systems, edamame has attracted increasing attention as an alternative protein source because of its adaptability to warm climates and relatively high rainfall conditions. The growing demand for plant-based protein has positioned edamame as a strategic commodity for food diversification and agricultural development in Indonesia (Ramadhani *et al*., 2016).

Based on BPS (2020), data, soybean imports increased during 2018–2019, from 2,585,809 kg in 2018 to 2,670,086 kg in 2019. Indonesia's heavy reliance on soybean imports requires strategic efforts to reduce this figure, including the development of edamame cultivation techniques appropriate to Indonesian agro-ecosystem conditions. In addition, Indonesia has significant market potential for edamame, both domestically and for export.

Edamame soybean development in Indonesia is considered highly promising due to its favorable environmental conditions. This plant thrives best in hot climates with relatively high rainfall, around 100–400 mm per month (Sahputra *et al*., 2016).

NASA Liquid Organic Fertilizer (LOF) contains various plant growth regulators (PGRs) that promote root development, accelerate growth during the vegetative phase, stimulate flowering and fruit formation, and reduce flower and fruit loss. The advantages of using LOF include ease of application, the presence of macro- and micronutrients (S, Ca, Mg, B, Mo, Cu, Fe, and Mn), as well as organic materials, and a faster nutrient absorption rate than solid fertilizers (Anggraeni *et al*., 2024). The presence of functional microbes in LOF also helps overcome nutrient deficiencies, increase soil fertility, and reduce dependence on inorganic fertilizers in plant cultivation systems. Sahfira's (2024), research results showed that the application of cow dung-based biocompost significantly affected the number of empty pods per sample, seed weight per sample, and seed weight per plot. However, they did not show a significant effect on plant height, flowering age, the number of full pods per sample, or 100-seed weight. Biocompost is an organic material used as a soil ameliorant and enriched with microorganisms. The use of biocompost encourages biodegradation, a biological process in which bacteria break down toxic compounds into simpler forms, and helps restore damaged ecosystems (Rosa *et al.*, 2023) .

RESEARCH METHODS

The experiment was conducted in the experimental field of the Faculty of Agriculture, Universitas Abulyatama, Aceh Besar Regency. A factorial Randomized Block Design was employed, consisting of two treatment factors. The first factor was the NASA LOF applied at four concentration levels, while the second factor was the biocompost applied at four dosage levels. Each treatment combination was replicated three times. Observed variables included plant height, number of pods per plant, and pod weight. Data were analyzed using analysis of variance, followed by the Honestly Significant Difference test at a 5% significance level when significant differences were detected. The experiments tried were as follows:

I. NASA LOF Fertilizer (P), which consists of 4 parts:

P_0 = 0 ml/L (Control)
P_1 = 5 ml/L per p.bag
P_2 = 10 ml/L per p.bag
P_3 = 15 ml/L per p.bag

II. Biocompost (B), which consists of 4 levels:

B_0 = 0 g/p.bag (Control)
B_1 = 50 g/p.bag (10 tons/ha)
B_2 = 100 g/p.bag (20 tons/ha)
B_3 = 150 g/p.bag (30 tons/ha)

The treatment combinations for NASA LOF and Biocompost are shown in Table 1.

Table 1. Composition of NASA LOF & Biocompost Treatment Combinations

No	Combination Treatment	Concentration NASA LOF	Dose Biocompost	
		ml/l/p.bag	grams/p.bag	tons/ha
1	P_0B_0	0	0	0
2	P_0B_1	0	50	10
3	P_0B_2	0	100	20
4	P_0B_3	0	150	30
5	P_1B_0	5	0	0
6	P_1B_1	5	50	10
7	P_1B_2	5	100	20
8	P_1B_3	5	150	30
9	P_2B_0	10	0	0
10	P_2B_1	10	50	10
11	P_2B_2	10	100	20
12	P_2B_3	10	150	30
13	P_3B_0	15	0	0
14	P_3B_1	15	50	10
15	P_3B_2	15	100	20
16	P_3B_3	15	150	30

The data were first subjected to an F-test, and if a significant effect was observed, a follow-up analysis was conducted using the 5% BNJ test.

RESULTS AND DISCUSSION

The Influence of NASA LOF Application

Plant Height

The average height of edamame soybean plants at the ages of 14, 28, and 42 DAP due to the application of NASA LOF is presented in Table 2.

Table 2. Average Height of Edamame Soybean Plants at 14, 28, & 42 DAP due to the Application of NASA LOF

Treatment NASA LOF	Tall Plant (cm)		
	14 DAP	28 DAP	42 DAP
P_0 (Control)	12.63 a	27.20 a	43.25 a
P_1 (5 ml/l/p.bag)	13.20 b	27.52 a	42.58 a
P_2 (10 ml/l/p.bag)	12.96 ab	27.85 a	42.75 a
P_3 (15 ml/l/p.bag)	13.15 b	27.75 a	42.58 a
BNJ 0.05	0.40	1.39	1.42

Note: Values sharing the same letter within a column do not differ significantly at the 5% significance level (BNJ).

Plant height responses to NASA LOF varied only during the early growth stage. At 14 DAP, certain treatment levels exhibited slightly higher plant height; however, these differences were not sustained at later observation periods. By 28 and 42 DAP, plant height among treatments showed no statistically meaningful variation, indicating a limited long-term effect of NASA LOF on vegetative growth. Overall, the LOF concentration of 15 ml/L per polybag resulted in the highest plant height compared with other LOF concentration treatments.

The application of NASA LOF at the age of 14 DAP has a very significant effect because the administration of NASA LOF can improve soil conditions, resulting in good soil rooting due to NASA LOF, so that the soil becomes loose, so that root growth and root symbiosis can run well, and is supported by the availability of high nutrients in the soil (Wahyudi *et al.*, 2021).

Number of Pods Per Plant

The average number of pods per edamame soybean crop resulting from the application of NASA LOF fertilizer is presented in Table 3.

Table 3. Average Number of Pods per Edamame Soybean Crop due to the NASA LOF Application

Treatment NASA LOF	Number of Pods Per Plant
P_0 (Control)	35.66 b
P_1 (5 ml/l per p.bag)	26.83 a
P_2 (10 ml/l per p.bag)	31.25 ab
P_3 (15 ml/l per p.bag)	26.58 a
BNJ 0.05	5.64

Note: Values sharing the same letter within a column do not differ significantly at the 5% significance level (BNJ).

Table 3 shows that the highest number of edamame soybean pods was found in the P_0 (Control) treatment, which was significantly different from the P_2 (10 ml/l per p.bag) treatment, but had no significant effect on the P_3 (15 ml/L per p.bag) and P_1 (5 ml/L per p.bag) treatments. The highest number of pods was found in the Nasa LOF treatment with P_0 concentration (control), which was not significantly different from P_2 (10 ml/L per p.bag).

This is thought to be due to soybeans having their nutrient requirements met and to improved chemical, physical, and biological soil conditions that allow plants to grow well, leading to an increase in pod number. The effect of NASA LOF treatment showed a significant difference in the total number of pods per crop, indicating that plants grow well when all required nutrients are sufficiently available to meet their needs (Walid & Susylowaty, 2016) .

Weight of Planting Pods

The average weight of edamame soybean pods resulting from the application of NASA LOF fertilizer is presented in Table 4.

Table 4. Average Pod Weight of Edamame Soybean Plants due to the NASA LOF Application

Treatment NASA LOF	Weight of Planting Pods (g)
P_0 (Control)	76.41 b
P_1 (5 ml/L per p.bag)	64.55 a
P_2 (10 ml/L per p.bag)	65.34 ab
P_3 (15 ml/L per p.bag)	62.68 a
BNJ 0.05	12.8

Note: Values sharing the same letter within a column do not differ significantly at the 5% significance level (BNJ).

Table 4 shows that the average value of the heaviest pod weight of edamame soybean plants was in the P0 (Control) treatment, which was significantly different from P_2 (10 ml/L), but not significantly different in the P_1 (5 ml/L) and P_3 (15 ml/L) treatments. The highest pod weight per plant was found in the NASA LOF treatment with P_0 (control), which was not significantly different from P_2 (10 ml/L per p.bag). This is suspected to be true without treatment, as the soil nutrients were already covered; therefore, the application of LOF was not optimal for soybean pod weight.

Effect of Biocompost Application

Plant Height

The average height of edamame soybean plants at 14, 28, and 42 DAP following biocompost application is presented in Table 5.

Table 5. Average height of Edamame Soybean Plants at 14, 28, and 42 days DAP due to Biocompost Application

Treatment Biocompost	Tall Plant (cm)		
	14 DAP	28 DAP	42 DAP
B_0 (Control)	13.10 ab	26.87 a	42.41 a
B_1 (50 g/p.bag)	12.97 a	27.58 a	43.08 a
B_2 (100 g/p.bag)	12.70 a	28.10 a	42.41 a
B_3 (150 g/p.bag)	13.16 b	27.77 a	43.25 a
BNJ 0.05	0.40	1.39	1.42

Note: Values sharing the same letter within a column do not differ significantly at the 5% significance level (BNJ).

Table 5 shows that the highest average plant height at 14 DAP was in treatment B_3 (150 g/p.bag), which was significantly different from B0 (control) but not significantly different from B_1 (50 g/p.bag) or B_2 (100 g/p.bag). At 28 and 42 GAP, the height of edamame soybean plants under biocompost fertilizer application showed no significant difference across all treatments tested. It is suspected that biocompost application has not increased plant height. Nutrient deficiencies will impact the vegetative growth of soybean plants (Santana *et al.*, 2021) .

Number of Pods Per Plant

The average number of pods per edamame soybean crop due to the influence of biocompost application is presented in Table 6.

Table 6. Average number of pods per edamame soybean crop due to the influence of biocompost application

Treatment Biocompost	Number of Planting Pods
B_0 (Control)	28.67 a
B_1 (50 g/p.bag)	29.50 a
B_2 (100 g/p.bag)	29.58 a
B_3 (150 g/p.bag)	32.58 a
BNJ 0.05	5.64

Note: Values sharing the same letter within a column do not differ significantly at the 5% significance level (BNJ).

Table 6 shows that applying biocompost did not produce significant differences in the mean number of soybean pods per plant across treatments. The highest pod number was observed in treatment B3 (150 g/p.bag), although it was not statistically different from B_0 (control), B_1 (50 g/p.bag), or B_2 (100 g/p.bag).

This is thought to be due to relatively low nutrient availability from rain leaching, and the leaves and the plant itself have absorbed the remaining nutrients that contribute to pod growth. Cow manure contains nutrients that play a vital role in stimulating flower, fruit, and seed formation (Ramadhani *et al.*, 2016) .

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Weight of Planting Pods

The average weight of edamame soybean pods due to the influence of Biocompost application is presented in Table 7.

Table 7. Average pod weight of edamame soybean plants due to the influence of biocompost application

Treatment Biocompost	Weight of Planting Pods (g)
B_0 (Control)	28.67 a
B_1 (50 g/p.bag)	29.50 a
B_2 (100 g/p.bag)	29.58 a
B_3 (150g/p.bag)	32.58 a
BNJ 0.05	5.64

Note: Values sharing the same letter within a column do not differ significantly at the 5% significance level (BNJ).

Table 7 shows that the average pod weight of soybean plants following biocompost application did not differ significantly across treatments. However, the highest overall value was obtained with the 150 g/p.bag biocompost treatment. This is suspected to be due to nutrient availability influencing growth and production. Furthermore, optimal growth and yield will be achieved if nutrient availability is sufficient and balanced (Arini *et al.*, 2022) .

CONCLUSION

The application of NASA LOF was not significantly different in the P_1 (5 ml/L per p.bag), P_2 (10 ml/L per p.bag), and P_3 (15 ml/L per p.bag) treatments on plant height growth at 14 DAP, but was not significantly different for all NASA LOF treatments. The highest number of pods per plant was found in the NASA LOF treatment at concentration P_0 (control), which was not significantly different from P_2 (10 ml/L per p.bag). The highest pod weight per plant was found in the NASA LOF treatment at concentration P_0 (control), which was not significantly different from P_2 (10 ml/L per p.bag).

Biocompost application significantly affected plant height at 14 DAP, but did not differ significantly at 28 and 42 DAP across treatment doses. The highest number of pods was found in biocompost treatment B_3 (150 g/polybag), which was not significantly different from B_0 (control), B_1 (50 g/p.bag), and B_2 (100 g/p.bag). Meanwhile, pod weight per plant showed no significant difference across treatment doses.

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