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RESPONSE OF GROWTH AND YIELD OF SOYBEAN PLANTS TO COMPOSITION OF PLANTING MEDIA AND APPLICATION OF LIQUID ORGANIC FERTILIZER

RESPON PERTUMBUHAN DAN HASIL TANAMAN KEDELAI TERHADAP KOMPOSISI MEDIA TANAM DAN PEMBERIAN PUPUK ORGANIK CAIR

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Abstract

This study aims to determine the growth and yield response of soybean plants to the composition of the planting medium and the application of liquid organic fertilizer, as well as the interaction between these two factors. The study was conducted in Neuheun Village, Mesjid Raya District, Aceh Besar Regency, Aceh Province, from July to September 2024, at an altitude of approximately 9.7 meters above sea level. The materials used included manure, burnt rice husks, compost, liquid organic fertilizer (LOF), Anjasmoro variety soybean seeds, and 40 cm x 50 cm polybags. The tools used included hoes, soil sieves, watering cans, hand sprayers, stationery, scales, calipers, and meters. The study found that the composition of the planting medium had a highly significant effect on plant height at 25, 35, and 45 days after planting. Still, they had no significant effect on stem diameter at 25, 35, and 45 days after planting. The composition of the planting medium had a significant impact on the number of productive branches at 35 days after planting, but had no significant effect on the number of productive branches at 25 and 45 days after planting, or on the weight of 100 dry seeds per plant. Liquid organic fertilizer had a highly significant effect on plant height at 35 DAP and a substantial impact at 25 and 45 DAP. However, liquid organic fertilizer had no significant effect on stem diameter, the number of productive branches at 25, 35, and 45 days after planting, or the weight of 100 dry seeds per plant.

***Keywords**: planting media, liquid organic fertilizer, soybean plants.*

Abstrak

Penelitian ini bertujuan mengetahui respon pertumbuhan dan hasil tanaman kedelai terhadap komposisi media tanam dan pemberian pupuk organik cair serta interaksi antara kedua faktor tersebut. Penelitian dilaksanakan di Desa Neuheun, Kecamatan Mesjid Raya, Kabupaten Aceh besar, Provinsi Aceh dari bulan Juli sampai dengan September 2024, dengan ketinggian ± 9,7 m dpl. Bahan yang digunakan adalah pupuk kandang, sekam bakar, kompos, pupuk organik cair (POC), benih kedelai varietas Anjasmoro, polybag ukuran 40 cm x 50 cm. Alat yang digunakan adalah cangkul, ayakan tanah, gembor, hand spayer, alat tulis menulis, timbangan, jangka sorong dan meteran. Hasil penelitian menunjukkan bahwa komposisi media tanam berpengaruh sangat nyata terhadap tinggi tanaman umur 25, 35, dan 45 hst, namun berpengaruh tidak nyata terhadap diameter batang umur 25, 35, dan 45 hst, berpengaruh nyata terhadap jumlah cabang produktif umur 35 hst, jumlah cabang produktif umur 25 dan 45 hst dan bobot 100 butir biji kering pertanaman. Pupuk organik cair berpengaruh sangat nyata terhadap tinggi tanaman umur 35, berpengaruh

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nyata terhadap tinggi tanaman umur 25 hst dan 45 hst, namun berpengaruh tidak nyata terhadap diameter batang dan jumlah cabang produktif umur 25, 35, dan 45 hst dan bobot 100 butir biji kering pertanam.

Kata kunci: media tanam, pupuk organik cair, tanaman kedelai.

INTRODUCTION

Soybeans (*Glycine max* L.*)* are the third most important food crop after rice and corn. They also play a crucial role in the food industry, including the production of tofu and tempeh, sweet and salty soy sauce, and animal feed. Soybeans are not native to Indonesia. They are thought to originate from the Central and Northern Plains of China. This is based on the spread of *Glycine ussuriensis*, a species thought to be the ancestor of G. max. Historical records of soybean cultivation and production also date back to the Chinese plains (Ngatimin *et al.*, 2019).

Soybeans contain alpha-linolenic acid, omega-6 fatty acids, and the isoflavones genistein and daidzein. Dried soybeans contain 34% protein, 19% oil, 34% carbohydrates, 17% dietary fiber, 5% minerals, and several other components, including vitamins and isoflavones. Soybeans are a good source of calcium, iron, zinc, phosphorus, magnesium, thiamine, riboflavin, niacin, and essential amino acids for humans. They are also a good source of protein and vegetable oil (Suryandari, 2021).

Soybeans are essential to meet increasing market demand driven by population growth. In addition to utilizing the seeds, the slightly dried leaves and stems can be used as animal feed and green manure (Marya ni, Astuti, Napitupulu, 2013). According to a report by the Central Statistics Agency (BPS), soybean demand has increased by 3.2 million tons of dry beans per year over the past five years, while domestic production is insufficient. Domestic soybean production reached 241,434 tons with a harvested area of 148,869 hectares in 2022. According to the national food balance sheet as of November 24, 2023, the annual soybean demand was 2,591,617 tons, or 215,968 tons per month (BPS, 2023).

The Aceh Agriculture and Plantation Service (Distanbun) stated that certified soybean seed production in the province reached 200 tons during the first semester of 2023, out of a total target of 500 tons by the end of the year. The target for soybean crops is only 610 tons due to the very few farmers in the region planting soybeans, despite the current high price of soybeans, ranging from Rp. 650,000 to Rp. 700,000 per sack (50 kg), or Rp. 13,000 to Rp. 14,000 (Aceh Agriculture & Plantation Service, 2023).

Efforts to increase soybean production can be made through, among other things, improving the growing medium and fertilization. Growing media can be made from one or more materials, and the nutrients contained in the medium can enhance plant growth. The most common growing media used by farmers includes a mixture of sand, soil, and manure. Familiar sources of organic matter in agriculture include compost, charcoal, humus, coconut fiber, sawdust, and banana stems. A good growing medium maintains root moisture, provides sufficient nutrients and oxygen, and enhances soybean plant growth and development (Sirait *et al.*, 2020).

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According to Mansyur *et al*. (2021), the nutrients in the planting medium are generally insufficient; therefore, additional nutrients must be provided through fertilization. One fertilizer that can increase nutrient levels is organic fertilizer. Organic fertilizer contains only plant and animal materials, such as organic waste from animals, plant remains, and other organic waste. Kustono, Widyanti, and Solichin (2019) stated that the form of organic fertilizer that can be used is Liquid Organic Fertilizer (LOF), a solution resulting from the decomposition of liquid organic materials derived from plant remains, animal waste, and other organic waste.

The application of organic fertilizer also serves as a supplement to meet plant nutrient needs. A complete and balanced nutrient supply affects plant growth and production by replenishing nutrients lost through leaching or carried away during harvest (Hadisuwito, 2012). LOF is relatively easy to use, readily absorbed by plants because its elements are already decomposed, and it does not damage the soil or plants even when used repeatedly (Ricca, 2015).

Research by Raksun (2014), found that the application of LOF at a concentration of 3.5 ml/polybag to 5.0 ml/polybag provided the best results for plant height. High Golden Organic, with a concentration of 5 ccl/liter of water applied to vegetable crops, significantly increased plant height, fruit number, and fresh weight compared to other concentrations (PT. Golden Medica International, 2022). Based on the description above, the author is interested in the effect of combining planting media with LOF on soybean plant productivity.

RESEARCH METHODS

This research was conducted in Gampong Neuheun, Mesjid Raya District, Aceh Besar Regency, with an altitude of ± 9.7 m above sea level. This research started from July to September 2024. The materials used were soybean seeds of the Anjasmoro variety, LOF High Golden Organic, topsoil, burnt rice husks, compost, manure, botanical pesticides made from soaked garlic and papaya leaves, and polybags measuring 40 cm x 50 cm. The tools used were hoes, sieves, sprayers, calipers, rulers, buckets, scissors, watering cans, scales, meters, and notebooks.

This study used a 3 × 3 factorial Randomized Block Design (RBD) with 3 replications. The factors studied were The composition of the planting media (M) consists of 3 levels, namely M_1 = Soil: Compost: Burnt rice husks (2: 2: 1), M_2 = Soil: Compost: Manure (2: 2: 1), and M_3 = Soil: Manure: Burnt rice husks (2: 2: 1) and the POC (P) provision factor consists of 3 levels, namely P_1 = 5 ml/L water, P_2 = 10 ml/L water, and P_3 = 15 ml/L water.

If the test shows a significant effect, the Least Significant Difference (LSD) test is used to compare the mean values of treatments at the 5% level ($LSD_{0.05}$). The parameters observed include plant height, stem diameter, number of productive branches, and the weight of 100 dry seeds per plant at 25, 35, and 45 days after planting (DAP).

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RESULTS AND DISCUSSION

The Influence of Planting Media

The F test showed that the planting medium had a highly significant effect on plant height at 25, 35, and 45 days after planting. The average soybean plant height at 25, 35, and 45 days after planting across various combinations of planting media is shown in Table 1.

Table 1. Average Height of Soybean Plants at 25, 35, and 45 DAP in Various Planting Media Compositions

Observed changes	The Influence of Planting Media			$BNT_{0.05}$
	M_1	M_2	M_3	
Plant height				
25 DAP	27.00 c	25.93 b	24.37 a	1.19
35 DAP	46.26 b	44.19 b	37.07 a	2.81
45 DAP	53.51 b	52.08 b	47.52 a	2.95
Stem diameter				
25 DAP	1.69	163	1.48	-
35 DAP	2.61	2.55	2.39	-
45 DAP	3.65	3.55	3.32	-
Number of productive branches				
25 DAP	2.00	1.82	1.52	-
35 DAP	4.52 b	4.15 ab	3.52 a	0.71
45 DAP	7.72	3.52 a	6.13	-
Weight of 100 dry seeds per planting	32.73	29.97	24.04	

Description: numbers followed by the same letter in the same column are not significantly different at 0.05 (BNT test)

Table 1 shows that the highest average soybean plant height at 25, 35, and 45 DAP was observed in the M_1 treatment. At 25 hst, the M1 treatment differed significantly from M2 and M3; at 35 and 45 DAP, the M1 treatment was not significantly different from M2 but was significantly different from M_3. This shows that the M1 treatments complement each other, enabling them to absorb nutrients more effectively and increasing soybean plant height. In addition, soybean plants harbor rhizobial bacteria that live on their roots and supply N nutrients. The planting medium consists of a mixture of components that provide water, nutrients, and support for the plant (Wiryanta, 2007).

The largest soybean stem diameter at 25, 35, and 45 DAP was observed in the M1 treatment, although it was not significantly different from M2 or M_3. This was because the planting media in the M1 treatment promoted vegetative growth in soybean plants. According to Dasri, Susilaningsih, and Zamorni (2020), compost and burnt rice husks can improve soil physical, chemical, and biological characteristics. Rice husk charcoal can also increase soil porosity, making it looser and improving its water absorption capacity.

The highest number of productive branches was observed at 25, 35, and 45 DAP in the M1 treatment. The composition of the M_1 planting medium had a significant effect on the number

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of productive branches at 35 DAP, but not at 25 or 45 DAP. This is because plants require proper nutrition to support the growth of productive branches. According to Adie (2016), meeting nutrient needs can stimulate the growth of productive branches in soybeans.

The weight of 100 dry soybean seeds was significantly higher in the M1 treatment than in M2 and M3, but not statistically significantly different from M2 or M_3. This shows that the composition of the planting medium, consisting of soil, compost, and burnt rice husks, provides a positive contribution to the weight of 100 dry seeds of soybean plants because soybeans can provide sufficient nutrients, such as mycorrhiza, which fix P elements that support root growth and the formation of flowers, fruits, and seeds. According to Pramana (2010) and Khasanah, Supriyanto, and Jazila (2022), good planting media provide plants with the nutrients they need in sufficient amounts, enabling plant growth and productivity.

The Effect of Liquid Organic Fertilizer (LOF)

The F-test results showed that LOF concentration had a very significant effect on plant height at 35 DAP and a significant effect at 25 and 45 DAP. The average soybean plant height at 25, 35, and 45 DAP across various LOF concentrations is shown in Table 2.

Table 2. Average Height of Soybean Plants at 25, 35, and 45 DAP at Various LOF Concentrations

Observed changes: Influence of planting media				$BNT_{0.05}$
	P_1	P_2	P_3	
Plant height				
25 DAP	24.74 a	26.07 b	26.48 b	1.19
35 DAP	39.45 a	43.11 b	45.49 b	2.91
45 DAP	48.67 a	52.96 b	51.48 ab	2.95
Stem diameter				
25 DAP	1.51	1.62	1.67	-
35 DAP	2.48	2.52	2.55	-
45 DAP	3.54	2.55	3.59	-
Number of productive branches				
25 DAP	1.67	1.74	1.93	-
35 DAP	3.74	4.07	4.37	-
45 DAP	6.57	6.98	7.43	-
Weight of 100 dry seeds per planting	27.03	29.26	30.48	

Description: numbers followed by the same letter in the same column are not significantly different in the 0.05 BNT test.

Table 2 shows that the highest average soybean yield at 25 and 35 DAP was in the P3 treatment, whereas at 45 DAP, the highest yield was in the P_2 treatment. This is because LOF contains sufficient nutrients for vegetative plant growth.

LOF HGO contains nutrients C-organic = 11.21%, N = 2.32%, P = 1.54%, K = 1.43%, Fe = 174.05 ppm, B = 40.29 ppm, Mo = 7.70 ppm., N is absorbed by plants in the form of nitrate (NO_3^-) which is a component of protein, amino acids, fats and chlorophyll which are important in the process of photosynthesis, so that it can stimulate the growth of leaves, stems and branches (PT. Golden Medica Internasional, 2022).

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The average diameter of soybean stems at 25, 35, and 45 DAP was highest in treatment P_3. However, statistically, it was not significantly different from P1. LOF had no significant effect on stem diameter; however, it provided sufficient nutrients for stem diameter enlargement in soybean plants in treatment P_3. However, several factors influence stem diameter, namely genetic and environmental factors. The function of the nutrient N in plants is to stimulate overall growth, mainly in stems, branches, and leaves. N plays an important role in the formation of green leaves, which are essential for photosynthesis and for the formation of proteins, fats, and other organic compounds (Raksun, 2014).

The highest number of productive branches on soybean plants at 25, 35, and 45 DAP was observed in the P3 treatment, but it was not statistically significantly different from P1 and P_2. This is because the LOF sprayed on the leaves can be readily absorbed by the plants, thereby stimulating the growth of more branches more quickly. Noviansyah *et al*. (2015), in Mulia (2024), added gibberellin, which promotes flower growth and stem elongation; auxin, which promotes root, stem, and leaf growth; and cytokinin, which promotes plant defense against temperature changes and viral infections.

The heaviest weight of 100 dry soybean seeds was found in treatment P_3, but it was not significantly different from P_1 or P_2. The plant more quickly absorbs the provision of LOF through the stem and leaf surface through the stomata and leaf cuticle, which will contribute to plant development, especially in the number of flowers and fruit produced. LOF contains macro- and micro-nutrients that play a vital role in soybean growth. P accelerates flowering, fruit, and seed ripening, while potassium (K) helps prevent pods from falling off and increases pod and seed production (Lingga & Marsono, 2013).

Interaction

The results of the F test in the analysis of variance showed that there was no significant interaction between the composition of the planting media and the concentration of LOF on all observed changes, namely plant height, stem diameter, and number of productive branches at the ages of 25, 35, and 45, as well as the weight of 100 dry seeds per plant.

CONCLUSIONS

Based on the research results, there was no significant interaction between the composition of the planting media and the concentration of LOF on plant height, stem diameter, number of productive branches at 25, 35, and 45 days after planting, and the weight of 100 dry seeds per plant. It is recommended that further research be conducted on other soybean varieties with different planting media compositions and LOF concentrations.

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