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The Effects of Rice Husk Ash and Goat Manure Application on the Growth of Mustard Plants (Brassica juncea L.) Varieties Tosakan

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Abstract:
Over the past decade, there has been a significant increase in market demand for spinach, rendering its outlook quite promising. However, the optimal growth of spinach has been hindered by low soil fertility. To address this issue, the application of organic materials has been considered to enhance soil fertility, thereby improving the chemical composition of the soil and facilitating the growth of red spinach. This study aims to determine the ideal dosage of rice husk ash and goat manure, as well as the potential interactions between these dosages, to maximize the growth and yield of spinach. The research was conducted in Villa Land, Pasir Mas, situated at an elevation of 26 meters above sea level in the Labuhanbatu district, from August to December 2020. The research design employed a factorial group consisting of two main factors. The first factor, rice husk ash (A), encompassed four levels: A0 = 0 ton/ha (control), A1 = 1 ton/ha (equivalent to 50 g/m2, the recommended dose), A2 = 1.5 tons/ha (equivalent to 75 g/m2), and A3 = 2 tons/ha (equivalent to 100 g/m2). The second factor, goat manure application (K), comprised three levels: K0 = 0 ton/ha (control), K1 = 2 ton/ha (equivalent to 200 g/m2, the recommended dose), K2 = 4 ton/ha (equivalent to 400 g/m2), and K3 = 6 ton/ha (equivalent to 600 g/m2). The parameters measured included plant height (cm), the number of leaves (strands), and weight per plant sample (g). The findings revealed that the application of 4 tons/ha of goat manure, equivalent to 400 g/m2, significantly increased plant height, the number of leaves, and the weight per plant of spinach. Additionally, the provision of 1.5 tons/ha of rice husk ash, equivalent to 75 g/m2, positively impacted plant height and the number of leaves in spinach plants.

Keywords: Rice Husk Ash, Red Spinach, Goat Manure, Plant Growth

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INTRODUCTION

The demand for spinach (Amaranthus gangeticus) in the market has been steadily increasing, presenting a promising opportunity for its cultivation (Harahap, Walida, & Arman, 2021). However, the growth of spinach (Amaranthus gangeticus) faces challenges, particularly when cultivated in soil dominated by inceptisol and ultisol types. Ultisol soil, in particular, is characterized by low soil fertility (Walida et al., 2020). To address this issue, the application of organic matter has been explored as a means to enhance soil fertility through physical, chemical, and biological improvements, thereby providing a conducive environment for the successful cultivation of red spinach (Rauf & Harahap, 2019).

An additional advantage of red spinach is its relatively short growth cycle, allowing farmers to quickly reap the rewards of their harvest. Spinach, with its edible leaves, originally hails from the American tropics but has now become a global crop, contributing to its significant economic value when compared to other spinach varieties (Oesman, Harahap, Rauf, & Rahmaniah, 2020). Spinach thrives best at the onset of the dry season when the land is lush and fertile. It can be successfully cultivated even in clayey soil, provided that adequate fertilizer is applied. The cultivation of red spinach in rice fields that have ample water supply through irrigation channels has proven to be effective (Agoesdy, Hanum, Rauf, & Harahap, 2019).

One commonly used organic fertilizer for improving soil structure and enriching soil fertility is composted organic matter, often referred to as "fertilizer loft" (Walida et al., 2020). Another traditional choice among farmers is the use of animal manure, such as goat or cattle dung. (Syawal, 2017) demonstrated that the application of goat dung as fertilizer, at a rate of 5 tons/ha on inceptisol soil, significantly increased organic carbon content and soil cation exchange capacity (KTK) compared to the control group.

The research conducted by (Syawal & Rauf, 2017) reveals that the application of goat manure at a rate of 10 tons/ha results in better fresh lettuce plant growth, particularly when accompanied by the addition of inorganic fertilizer. In addition to the beneficial effects of manure, another valuable source of nutrients and soil improvement is rice husk ash. Rice husk, when incinerated, yields ash that is rich in silica and various elements (Beidaghy Dizaji et al., 2019). According to (Walida et al., 2020), rice husk ash boasts a composition that includes approximately 90.23% silica, 0.39% potassium oxide (K2O), 2.54% alumina (Al2O3), 2.23% carbon, 1.58% calcium oxide (CaO), and 0.53% magnesium oxide (MgO). The application of rice husk ash to the soil enhances soil aeration, facilitating air and water movement within the soil, and greatly benefiting the root system of plants (Walida, Harahap, & Dalimunthe, 2019).

Rice husk ash is the residue obtained after the incineration of rice husks. It appears as a white to grey-brown substance, characterized by a high content of cellulose, lignin, hemicellulose, and, when burned, it can yield ash with a relatively high silica content, ranging from 87% to 97%. It also contains nutrients such as 1% nitrogen (N) and 2% potassium (K)

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(Walida et al., 2019). The application of rice husk ash significantly impacts the growth rate and height of plants, as well as acts as a deterrent to pests and diseases in crops such as tomatoes (Walida et al., 2020).

Rice husk ash, when considered from a physical standpoint, exhibits several characteristics that make it a valuable soil amendment for clayey soils. One of its prominent attributes is its lightweight texture, which is particularly advantageous when it comes to enhancing the physical properties of clayey soils (Chatterjee, Gajjela, & Thirumdasu, 2017; Paul, 2016). Clayey soils are known for their fine particles and dense structure, which can lead to poor drainage, compaction, and reduced aeration. These issues can hinder root growth and overall plant development (Jalal, Mulk, Memon, Jamhiri, & Naseem, 2021; Jittin, Bahurudeen, & Ajinkya, 2020; Pushpakumara & Mendis, 2022).

The lightweight nature of rice husk ash helps counterbalance the inherent heaviness of clayey soils. When incorporated into the soil, it acts as a natural soil conditioner, effectively reducing soil density and improving its overall structure. This means that the soil becomes less compacted and better aerated, allowing plant roots to penetrate more easily and access essential nutrients and water (Batey, 2009; Pushpakumara & Mendis, 2022; Wolkowski, 1990).

Additionally, rice husk ash contributes to addressing deficiencies in organic elements in clayey soils. These soils often lack essential organic matter, which is crucial for retaining moisture, improving nutrient availability, and fostering beneficial microbial activity (Chatterjee et al., 2017; Paul, 2016). The incorporation of rice husk ash enriches the soil with organic carbon, enhancing its capacity to hold moisture and nutrients, which, in turn, benefits plant growth (Selvarajh, Ch'ng, Md Zain, Sannasi, & Mohammad Azmin, 2020).

In summary, rice husk ash's lightweight texture plays a pivotal role in improving the physical properties of clayey soils. Its ability to reduce soil density, enhance aeration, and address organic matter deficiencies makes it a valuable soil amendment for agricultural purposes. By incorporating rice husk ash into clayey soils, farmers and growers can create a more conducive environment for plant growth, leading to better yields and healthier crops (Chatterjee et al., 2017; Selvarajh et al., 2020). Furthermore, rice husk ash enhances soil porosity, leading to better soil aeration, which is especially beneficial for the growth and development of plant roots, particularly in the case of plants with shallow and delicate root systems, such as tomatoes and peppers (Rahmawaty, Frastika, Rauf, Batubara, & Harahap, 2020).

This study is designed to determine the optimal dosage of goat manure, the appropriate amount of rice husk ash, and the potential interactions between these dosages to promote the growth of Red Spinach (Amaranthus Gangeticus).

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MATERIALS AND METHOD

This research, carried out land June sand ,mas graha village failed to compass with a height of 18 meters above sea level Labuhanbatu District in the month of August until December 2020. The material used is red spinach seeds, rice husk ash, water, chemical substances used for the purposes of analysis of soil and plants in the laboratory.

The tool used is a poly bag size 35x40, knife cutter,analytical scales, a ruler, scissors, mortar, measuring flask, bucket, caliper, tali rapiah, hoes, poly bag, tape measure, scales, and a number of tools that are used in the laboratory for chemical analysis of soil and plant. The study will be conducted with the design group factorial. Research design using group factorial consisting of two factors. The first factor of rice husk ash (A) consists of 4 levels, namely : A_0 = 0 ton/ha (control), A_1 = 1 ton/ha equivalent to 50 g/m2 (the recommended dose), A_2 = 1.5 tons/ha, equivalent to 75 g/m2. The second factor, namely the granting of goat manure (P) with three levels, namely : P0 = 0 ton/ha (control) P_1 = 2 ton/ha, equivalent to 200 g/m2 (the recommended dose), P_2 = 4 ton/ha, equivalent to 400 g/m^2, P_3 = 6 ton/ha, equivalent to 600 g/m^2. The number of treatment combinations is 12 combinations. (Gomes and Gomes, 1995). The Parameters measured were plant height, leaf number , Weight per Plant Sample (g).

RESULTS AND DISCUSSIONS

The response of the growth of red spinach (Amaranthus gangeticus) with the provision of goat's manure and rice husk ash on the parameters of plant height, leaf number,weight per plant sample (g) plant spinach red disajikam in Table 1, 2 and 3.

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Plant height of spinach (*Amaranthus Gangeticus*)

The results of different test average influence of goat manure and rice husk ash on plant Height are presented in Table 1.Based on the results of different test average in Table 1 shows that the application of goat manure and rice husk ash significantly affect the plant height of spinach while the interaction of the goat's manure and rice husk ash significantly affect the plant height of spinach. Based on the results of different test average in Table 1 shows that the granting of goat manure P_0 (control) significantly different with all the standard of the other (P_1, P_2, and P_3). The level of K_1 differ markedly with the level of K_2 and K_3, while the level of K_2 (4 tons/ha, equivalent to 400 g/m2) was not significantly different with a level of K_3(6 tons/ha, equivalent to 600 g/m2).

In goat manure frequency plant spinach red is highest at the level of P_2 (24,68 cm) and the lowest at the level of K_0 (21,63 cm). While the provision of rice husk ash A_0 (control) significantly different with all the standard of the other (A_1 and A_2).Level A_1 is not significantly different with a level A2 on the plant height of spinach. On treatment of rice husk ash frequency plant spinach red is highest on the level A2 (were 23.69 cm) and the lowest at the level of A0 (22,57 cm).

Table 1. The influence of a combination of goat manure and rice husk ash to the height (cm) plant spinach (*Amaranthus Gangeticus*)

Goat Manure	Rice Husk Ash			Average
	A_0	A_1	A_2	
P_0	20,67	21,27	22,13	21,36 c
P_1	22,22	22,43	23,45	22,70 b
P_2	23,16	23,59	23,91	23,55 a
P_3	24,23	24,55	25,25	24,68 a
Average	22,57 b	22,96 a	23,69 a	

Description : Numbers followed by the same letter mean different not real (5%) according to the test DMRT

From the results of analysis of variance showed that the dosage of rice husk ash effect is very real at high planting spinach, plant Height is a measure of the plant are often observed, both as an indicator of growth as well as the parameters used to measure the influence of the environment or the applied treatment. This is based on the fact that plant height is a measure of growth that is most easily seen (Rahmawaty et al., 2020).

This is presumably because rice husk ash is able to provide the availability of nutrients sufficient for the growth of generative plants. Results of the study Luta *et al.*, (2020), treatment with the addition of manure had no apparent effect on plant height. The use of manure fertilizer in a sustainable manner provide a positive impact on the fertility of the soil. Fertile soil will facilitate root development of the plant. The roots of the plants that can grow well so it is easy to absorb water and nutrients tersedoia in the soil so that plants can grow and develop optimally and produce high yields (Solar *et al.*, 2019).

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The number of leaves (strands) plant spinach (*Amaranthus Gangeticus*)

The results of different test average influence of goat manure and rice husk ash on Number of leaves (strands) are presented in Table 2. Based on the results of different test average in Table 2 show that the application of goat manure and rice husk ash significantly affect the Number of leaves (strands) spinach while the interaction of the goat's manure and rice husk ash did not significantly affect Number of leaves (strands) of spinach. Based on the results of different test average in Table 2 show that the granting of goat manure K_0 (control) significantly different with all the standard of the other (K_1, K_2, and K_3). The level of K 1 differs markedly with the level of K 2 and K 3, while the level K_2 (4 tons/ha, equivalent to 400 g/m2) was not significantly different with the level of K_3(6 tons/ha, equivalent to 600 g/m2).

Table 2. The influence of a combination of goat manure and rice husk ash on number of leaves (strands) spinach (Amaranthus Gangeticus)

Goat Manure	Rice Husk Ash			Average
	A_0	A_1	A_2	
P_0	5,00	6,00	7,00	5,00 c
P_1	7,00	6,00	8,00	7,00 b
P_2	7,00	10,00	9,00	8,77 a
P_3	8,00	8,00	9,00	8,33 a
Average	6,75 b	7,50 b	8,25 a	

Description : Numbers followed by the same letter mean different not real (5%) according to the test DMRT

In goat manure number of leaves (strands) red spinach is highest at the level of K 2 (8,77 strands) and the lowest level K 0 (5,00 strands). While the provision of rice husk ash. A0 (control) significantly different with all the standard of the other (A1 and A2).Level A1 is not significantly different with a level A2 on the Number of leaves (strands) of spinach. On treatment of rice husk ash the Number of leaves (strands) plant spinach red is highest on the level A2 (8,25 strands) and the lowest at the level of A0 (of 6.75 strands). This shows the different treatment of the real with all the treatment this is due to the growth of the roots of the plant spinach red already optium so that the absorption of nutrient elements from the soil can be running well so influential right against the growth of leaves Blanco *et al.*, (2013) stated that elements (N), (P) and (K) plays a role in stimulating cell division in tissue meristem apex that will stimulate the elongation of cells so that the plants will grow high, cell division in the meristems of the apex also will be followed by cell division primordia of leaves that will form the leaf will be.

Weight Per Plant Of Spinach (*Amaranthus Gangeticus*) (g)

The results of different test average influence of goat manure and rice husk ash on Weight per Plant (g) are presented in Table 3. Based on the results of different test average in Table 3 show that the application of goat manure and rice husk ash significantly affect the Weight per Plant (g) spinach while the interaction of the goat's manure and rice husk ash did

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not significantly affect the Weight per Plant (g) of spinach. Based on the results of different test average in Table 3 show that the granting of goat manure i.e. L0 (control) significantly different with all the standard of the other (K_1, K_2, and K_3). The level of K1 differs markedly with the level of K_2 and K_3, while the level K 2 (4 tons/ha, equivalent to 400 g/m2) was not significantly different with the level of K_3(6 tons/ha, equivalent to 600 g/m2). In goat manure Weight per Plant (g) red spinach is highest at the level of K 3 (18,04 g) and the lowest at the level of L0 (to 16.56 grams). While the provision of rice husk ash Weight per Plant (g) plant spinach red is highest on the level A2 (17,66 g) and the lowest at the level of A0 (17,12 g).

Table 3. The influence of a combination of goat manure and rice husk ash on Weight per Plant Sample (g) red spinach (*Amaranthus Gangeticus*)

Goat Manure	Rice Husk Ash			Average
	A_0	A_1	A_2	
P_0	16,47	16,53	16,67	16,56 c
P_1	16,89	18,02	17,44	17,45 b
P_2	16,88	18,65	17,56	17,70 ab
P_3	18,23	17,45	18,43	18,04 a
Average	17,12	17,66	17,53	

Description : Numbers followed by the same letter mean different not real (5%) according to the test DMRT

This is presumably because the growth rate continues to increase with the presence of goat manure and rice husk ash so that meet the needs of nutrient content to the plants, increasing doses of goat manure and rice husk ash then the growth of the plants the better thus increasing the production of plant red spinach. Where the administration of the goat's manure and rice husk ash, will increase the growth of plants green spinach and physiological processes in the plant tissue will go well, so the result of photosynthesis is translocated into the plant. This is in accordance with the statement of (Pane, Damanik, & Sitorus, 2014), which states that to form the tissues of plants needed nutrient elements, with the elements that is balanced will add to the weight of the plant.

CONCLUSIONS

The utilization of goat manure in agriculture has proven to be an effective strategy in enhancing the growth and development of various plant species. In this context, a study conducted on red amaranth (Amaranthus Gangeticus) has shed light on the positive impact of different manure application rates on plant characteristics. One of the key findings from the research is that the application of 4 tons/ha of goat manure, equivalent to 400 g/m2, significantly influences the growth parameters of red amaranth. Plant height, an important indicator of plant health and vigor, exhibited noticeable improvement with this manure rate. Moreover, the number of leaves per plant also increased, suggesting that goat manure contributes to the overall leafy biomass of red amaranth. Additionally, the weight per individual plant saw a substantial increase, indicating the potential for greater yield in terms of both quantity and quality. Furthermore, the study revealed that even a lower application rate of 1.5 tons/ha, equivalent to 75 g/m2, had a positive impact on specific plant characteristics. Plant height continued to show improvement, and the number of leaves per

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plant increased. These findings emphasize the versatility of goat manure as a resource for enhancing the growth and productivity of red amaranth. In conclusion, the research highlights the significant role that goat manure can play in promoting the growth and development of red amaranth. The study's results indicate that different application rates of goat manure have a positive influence on plant height, leaf count, and individual plant weight, all of which contribute to the overall health and yield of red amaranth. This information can be valuable for farmers and agricultural practitioners looking to optimize their crop production while also considering sustainable and organic fertilization practices.

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