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Effect of Several Types of Compost on The Growth and Yield of Rice

Budi Santosa[1], Muhammad Amri[1], Yurma Metri[1)] and Desi Ratna Sari[2]

[1]Agricultural Extension Study Program,
[2]Food Technology, Faculty of Science, Social Affairs and Education, Prima Nusantara University, Bukittinggi West Sumatera 26111 Indonesia

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ABSTRACT

Compost is an organic fertilizer produced through the decomposition of plant residues, animal waste, and other organic materials, playing a vital role in enhancing soil fertility, nutrient availability, and microbial activity. This study aimed to evaluate the effectiveness of various compost types on the growth and yield of rice. The experiment was conducted in Nagari Koto Baru, Solok Regency, from July to December 2022, using a Randomized Block Design (RBD) with six treatments of compost type and four replications: no compost, kirinyuh (*Chromolaena odorata)*, rice straw, grass, corn leaf, and cow dung compost. The dose of compost used in all treatments was the same, at 100 g per pot. Composting was carried out for 30 days, utilizing PROMI microorganisms to accelerate decomposition. Data were analyzed using analysis of variance and Duncan's New Multiple Range Test at a 5% significance level. The results indicated that kirinyuh compost produced the best response across all observed parameters, including plant height (76.20 cm), number of leaves (79.80), number of tillers (30.50), number of productive tillers (28.00), panicle length (26.00 cm), number of grains per panicle (170.00), weight of 1,000 grains (28.00 g), and grain weight per pot (105.00 g). This yield corresponds to a potential production of 9.45 $t.ha^{-1}$. These findings highlight Kirinyuh compost as a promising local organic fertilizer capable of sustainably increasing rice productivity while improving soil health.

Keywords: *Oryza sativa*; *Chromolaena odorata*; Organic fertilizer; potential production
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INTRODUCTION

Compost is an organic fertilizer derived from household waste, plant waste, market waste, and other sources, and is produced through a composting process (Manea et al. 2024). Sucipto (2012) stated that compost is the decomposition of organic materials that are no longer used, where the organic materials can be plants, animals, and other elements of life. Compost has benefits as a fertilizer because it is composed of organic materials derived from living organism. Indriani (2012) stated that compost is the result of fermentation or decomposition of organic materials such as plants, animals, or organic waste. Compost used as fertilizer is also called organic fertilizer because its composition consists of organic materials. Compost has several beneficial properties, including the following: 1) Improves the structure of clay soil so that it becomes light, 2) Increases the binding capacity of sandy soil so that the soil does not crumble, 3) Increases the water binding capacity of the soil, 4) Improves drainage in the air system in the soil, 5) Increases the binding capacity of the soil to nutrients, 6) Contains complete nutrients, even though the amount is small, 7) Helps the weathering process of mineral materials, 8) Provides food availability for microbes, and 9) Reduces the activity of harmful microorganisms (Siebielec et al. 2020; Rivier et al. 2022; Wang et al. 2022; Suvendran et al. 2025).

The principle of composting is to reduce the C/N ratio of organic matter to the same as the C/N of the soil. The higher the C/N of the material, the longer the composting process will be because the C/N must be reduced. In the composting process, changes occur to reduce or eliminate carbohydrate levels and increase soluble N compounds (*ammonia*). Thus, the C/N is lower and relatively stable, approaching the C/N of the soil (Azis et al. 2023; Sathya et al. 2024; Shen et al. 2024).

Kirinyuh (*Chromolaena odorata L.)* compost contains elements N: 2.95%, P2O5: 0.35%, and K2O: 3.02%. Rice straw compost contains elements Nitrogen (N): 2.11%, Phosphorus (P2O5): 0.64%, Potassium (K2O): 7.7%, Calcium (Ca): 4.2%, and micro elements Magnesium (Mg): 0.5%, Cu: 20 ppm, Mn: 684 ppm, and Zn: 144 ppm. Grass compost has a good C/N value of 7.6, and the nutrient content is complete, both macro and micro nutrients, and the compost pH for pH (H2O) = 6.86, and pH (KCL) = 6.76. Corn leaf compost contains elements of water content: 7.20%, N: 1.05%, P2O5: 1.01%, K2O5: 0.18%, CaO: 1.98%, MgO: 0.53%, Fe: 0.19%, Organic C: 10.5%, and C/N: 9.97. Cow dung

**Corresponding Author*:
E-Mail: budisolok02@gmail.com

compost contains nutrients of Nitrogen 0.33%, Phosphorus 0.11%, Potassium 0.13%, Calcium 0.26% (Pramono 2020).

Increasing soil fertility by providing organic matter is crucial for maintaining high yields of rice. However, organic matter applied to the soil must be in a decomposed or advanced decomposition condition. In an effort to increase the productivity of rice fields sustainably, a breakthrough is needed that leads to farming efficiency by utilizing local resources, namely compost. The addition of organic matter is an action to improve the plant growing environment that can increase fertilizer efficiency. Data from Dataindonesia (2022), shows that fertilizer consumption in Indonesia from 2017 to 2022 reveals that the use of urea fertilizer is significantly higher than that of organic fertilizer. Therefore, proper socialization is needed for optimal production and use of organic fertilizers. The results of research on the use of organic materials, such as decomposed plant residues, compost, manure, or liquid organic fertilizers, show that organic fertilizers can increase soil productivity and fertilization efficiency and reduce fertilizer needs, especially N, P, and K fertilizers. This study aims to evaluate the suitability of various compost types for promoting the growth and yield of rice plants (*Oryza sativa* L.).

MATERIALS AND METHODS

The research was conducted in Nagari Koto Baru, Kubung District, Solok Regency, with an altitude of 388 m above sea level (asl) from July to December 2022. The materials used in this study were: Anak Daro variety rice grains, Kirinyuh compost, rice straw compost, grass compost, corn leaf compost, cow dung, 35 x 45 cm plastic buckets (pots), PMK soil, paranet, raffia rope, and water. The tools used in this study were: crowbar, hoe, machete, sickle, saw, meter, sieve, bucket, stakes, stationery and other supporting materials and tools. The study used a Randomized Block Design with six treatments of several types of compost and four groups as follows: compost (Control), kirinyuh, rice straw, grass, corn leaf compost, and cow dung compost. The dose of compost used in all treatments was the same, which was 100 g.pot^{-1}.

The composting process, which is a biological process by utilizing microorganisms to convert organic materials (Kirinyuh, rice straw, grass, corn leaves, and cow dung) into compost using PROMI (promoting microbes) for one month (30 days). Organic materials (Kirinyuh, rice straw, grass, corn leaves, and cow dung) were chopped into small pieces and then placed in a 20-liter bucket. PROMI bioactivator containing the microbes *Trichoderma harzianium DT38*, *T. pseudokoningii*, *Aspergilus sp*, and white rot fungi was stirred in water evenly and then sprinkled on each organic material in the bucket, then the bucket was covered with plastic. Once a week, the organic material was stirred periodically to provide oxygen and help the decomposition process. After 30 days, the compost was ready to use, with a blackish color and a texture that had been destroyed, but it did not smell bad. Compost application was by sprinkling around the roots of the plants at the age of 1 week after planting, in each treatment of all plant samples in the study.

The observation data were analyzed using analysis of variance. If the calculated *F* result of the treatment was greater than the *F* table of 5%, it was continued with further testing of Duncan's New Multiple Range Test (DNMRT) at a significant level of 5%.

RESULTS AND DISCUSSION

Plant height (cm) and number of leaves (strands)

The results of the analysis of variance of several types of compost on rice plants on the parameters of plant height and number of leaves showed significantly different effects. The highest plant height in the 100 g.pot^{-1} Kirinyuh compost treatment was 76.20 cm, and the highest number of leaves in the 100 g.pot^{-1} Kirinyuh compost treatment was 79.80 strands. In the control treatment, which served as the basic treatment for comparison with the provision of several types of compost, the data obtained were the lowest plant height of 68.50 cm and the lowest number of leaves, 50.50 strands.

Table 1. Plant height and number of leaves (blades) of several types of compost treatment on rice

Compost types	Plant height (cm)	Number of leaves(blades)
No compost	68.50±0.71c	50.50±0.71d
Kirinyuh	76.20±0.37a	79.80±0.57a
Rice straw	74.20±0.60a	77.20±0.28b
Grass	73.50±0.71b	76.00± 0.71b
Corn leaf	72.80±0.49b	72.00±1.41c
Cow dung	72.50±0.71b	70.20±0.88c
CV (%)	5.45	4.75

Remarks: The numbers in the columns followed by the same lowercase letter are not significantly different according to the DNMRT follow-up test at the 5% significance level.

Table 1 shows that Kirinyuh compost yielded the best response in terms of plant height and leaf number in rice plants. The provision of rice straw compost, grass compost, corn leaf compost, and cow dung compost had no significant effect on the plant height parameters. Meanwhile, the provision of rice straw compost and grass compost had no significant effect on the parameters of the number of leaves, and the provision of corn leaf compost and cow dung compost also had no significant effect on the parameters of the number of leaves. According to Nasrullah et al. (2020), Kirinyuh biomass contains nutrients of 2.65% N, 0.53% P, and 1.9% K, so that Kirinyuh biomass can be used as a potential source of organic material to improve soil fertility and increase yields and crop production.

The results of Pramono (2020) stated that Kirinyuh compost can optimize the production of purple eggplant plants and obtain a profit of IDR 1,166,168, with an R/C ratio of 2.48 and a profitability of 148.5%, so this method is feasible to continue. Compost not only adds nutrients, but also maintains soil function so that plants can grow well. In addition, compost functions to improve soil structure, increase the soil's ability to retain water and optimize soil biological activity (Ho et al. 2022). Kirinyuh is one of the compost materials that grows in all places and various types of soil. This material can be used as an alternative source of organic material and nutrients that are cheap and easy to obtain for plant cultivation efforts. Number of tillers per clump (stem) and number of productive tillers per clump (stem) (Munir et al. 2018; Panjaitan et al. 2018; Suryanto et al. 2020; Tulungen et al. 2023).

The results of the analysis of variance of several types of compost on rice plants on the parameter of the number of tillers per clump gave a significantly different effect, and the parameter of the number of productive tillers per clump gave a significantly different effect. The highest number of tillers per clump was in the 100 g.pot^{-1} Kirinyuh compost treatment, namely 30.50 stems, and the highest number of productive tillers was in the 100 g.pot^{-1} Kirinyuh compost treatment, namely 28.00 stems. In the control treatment, which served as the basic treatment for comparison with the provision of several types of compost, the data obtained were the lowest number of tillers per clump at 8.50 stems and the lowest number of productive tillers per clump at 5.00 stems.

Table 2. Number of tillers per clump and number of productive tillers per clump of several types of compost treatment on rice plants

Compost types	Number of tillers per clump	Number of productive tillers per clump
No compost	18.50±0.71c	15.00±0.29c
Kirinyuh	30.50±0.71a	28.00±1.41a
Rice straw	28.50±0.71b	25.00±1.41b
Grass	27.50±0.71b	24.00±1.41b
Corn leaf	26.80±0.29b	24.00±1.41b
Cow dung	25.60±0.57b	23.00±1.41b
CV (%)	5.10	5.50

Remark: The numbers in the columns followed by the same lowercase letter are not significantly different according to the DNMRT follow-up test at the 5% significance level.

Not all rice tillers that are formed produce panicles. Productive rice tillers are tillers that are able to produce panicles. The number of tillers formed will affect the number of productive tillers and, in turn, impact the harvest yield (Barus and Rauf 2021). (Anggraini et al. 2013) stated that the ability of plants to photosynthesize significantly affects plant growth in producing a greater number of tillers. Table 2 shows that Kirinyuh compost gave the best response to the parameters of the number of tillers per clump and the number of productive tillers per clump of rice plants.

The provision of rice straw compost, grass compost, corn leaf compost, and cow dung compost had no significant effect on the parameters of the number of tillers per clump and the number of productive tillers per clump. Yulianda et al. (2022), Kirinyuh organic material plays a crucial role in enhancing soil and plant productivity, and is readily available but not optimally utilized by farmers. Kirinyuh compost has a fairly high nutrient content, specifically N 3.90%, P 0.27%, and K 1.69%, which enables this weed biomass to improve the physical, biological, and chemical properties of the soil, ultimately providing optimal results for plants.

Panicle length and number of grains per panicle

The results of the analysis of variance of several types of compost on rice plants on the parameter of panicle length gave a significantly different effect and the parameter of the number of grains per panicle gave a significantly different effect. The highest panicle length in the 100 g.pot^{-1} Kirinyuh compost treatment was 26.00 cm and the highest number of grains per panicle was in the 100 g.pot^{-1} Kirinyuh compost treatment, namely 170.00 pieces. In the control treatment which was considered as the basic treatment and used to compare with the provision of several types of compost, the lowest panicle length data was 18.00 cm and the number of grains per panicle was at least 130.00 pieces.

Table 3. Panicle length and number of grains per panicle of several types of compost treatment on lowland rice plants

Compost types	Panicle length (cm)	Number of grains per panicle
No compost	18.00±1.41c	130.00±1.41d
Kirinyuh	26.00±1.41a	170.00±2.45a
Rice straw	24.50±0.71b	169.00±1.41a
Grass	24.00±0.00b	162.00±1.41c
Corn leaf	23.80±0.29b	165.00±1.41c
Cow dung	23.50±0.71b	163.00±1.41c
CV (%)	4.70	5.60

Remark: The numbers in the columns followed by the same lowercase letter are not significantly different according to the DNMRT follow-up test at the 5% significance level.

Table 3 shows that Kirinyuh compost gave the best effect on the parameters of panicle length and number of grains per panicle of rice plants. The provision of rice straw compost, grass compost, corn leaf compost, and cow dung compost had no significant effect on the parameter of panicle length. Meanwhile, the provision of grass compost, corn leaf compost, and cow dung compost had no significant effect on the parameter of number of grains per panicle.

The length of rice plant panicles can be divided into three sizes, namely short panicles (less than 20 cm), medium panicles (between 20 and 30 cm), and long panicles (more than 30 cm). Seed yield as one part of the plant sink is determined by the yield components, such as seed size/weight, panicles originating from primary, secondary, and tertiary rice tillers, and subsequent tiller panicles. The ability to produce types of rice panicles and the productivity level of each panicle will determine the total productivity of the plant. Panicles that appear later, such as tertiary panicles, contribute less to yield (Mohanan and Mini 2007).

Weight of 1,000 grains and weight of grains per pot

The results of the analysis of variance of several types of compost on rice plants on the parameter of 1,000 seed weight showed a significantly different effect and the parameter of grain weight per pot showed a significantly different effect. The highest weight of 1,000 grains in the 100 g.pot^{-1} kirinyuh compost treatment was 28.00 g, and the highest weight of grain per pot was in the 100 g.pot^{-1} kirinyuh compost treatment, namely 105.00 g. In the control treatment, which was considered the basic treatment and used to compare with the provision of several types of compost, the data obtained were the lowest weight of 1,000 grains of 20.00 g, and the weight of grain per pot was at least 80.00 g.

Table 4. Weight of 1,000 grains and weight of grain per pot of several types of compost treatment on lowland rice plants

Compost types	Weight 1,000 grains (g)	Weight of grains per pot (g)
No compost	20.00±1.41c	80.00±1.41d
Kirinyuh	28.00±0.00a	105.00±1.41a
Rice straw	26.50±0.71b	98.50±0.71b
Grass	25.50±0.71b	95.00±0.00c
Corn leaf	25.00±0.00b	93.00±1.41c
Cow dung	25.50±0.71b	94.00±1.41c
CV (%)	4.95	5.05

Remark: The numbers in the columns followed by the same lowercase letter are not significantly different according to the DNMRT follow-up test at the 5% significance level.

The weight of 1000 grains is one of the indicators of the quantity and quality of rice plants. The weight of 1000 grains is determined in the generative phase and is influenced by the seed coat, which is determined by the phase before ripening. Table 4 shows that the Kirinyuh compost gave the best response to the parameters of the weight of 1,000 grains and the weight of grain per plot. The provision of rice straw compost, grass compost, corn leaf compost, and cow dung compost had no significant effect on the parameter of the weight of 1,000 grains. While the provision of grass compost, corn leaf compost and cow dung compost had no significant effect on the parameter of the weight of grain per pot.

The production results of rice plants were determined by the number of productive tillers, the number of grains per panicle, and the weight of 1,000 grains. The results of previous research explained that the use of kirinyuh compost as green fertilizer with a dose of 10 t.ha^{-1} can increase rice production by 9-15%. Kirinyuh compost as green fertilizer can increase peanut seed yields by 29.79% with a seed yield of 2 t.ha^{-1}, and its effect can match manure, and exceeds the effect of gamal compost pruning (*Gliricidia* sp.) (1.84 t.ha^{-1}), while the effect of Kirinyuh compost residue for the next planting season shows a higher effect, namely with a seed yield of 2.5 t.ha^{-1} which matches the effect of manure residue (Murthy 2012; Jamilah and Juniarti 2017; Suryanto et al. 2020; Suntoro et al. 2024).

CONCLUSIONS

Based on the results of the research that has been carried out, it can be concluded that the treatment of giving 100 g.pot^{-1} of kirinyuh compost gave the highest results for all observation parameters, namely: plant height, number of leaves, number of tillers per clump, number of productive tillers per clump, panicle length, number of grains per panicle, weight of 1,000 grains and weight of grain per pot. The highest grain weight per pot was 105.00 g, in the treatment of giving 100 g.pot^{-1} of kirinyuh compost or equivalent to a potential yield of 9.45 t.ha^{-1}.

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