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The Effect of Different Levels of Compost Application on The Productivity of Various Types of Grasses

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ABSTRACT. *This study aimed to evaluate the effect of different levels of compost fertilizer on the productivity of three forage grass species: odot grass (Pennisetum purpureum cv. Mott), elephant grass (Pennisetum purpureum), and pakchong grass (Pennisetum purpureum cv. Purple). The experiment was conducted over a two-month period using a one-way Completely Randomized Design (CRD) with four treatments: no compost (P0), 30% cow feces compost (P1), 50% cow feces compost (P2), and 70% cow feces compost (P3). The observed parameters included number of leaves, number of tillers, plant height, and stem diameter. The results indicated that compost application generally had no significant effect on the number of leaves and tillers for all grass types, except for a significant difference in the number of tillers in pakchong grass. The application of 70% cow feces compost (P3) significantly affected the plant height and stem diameter of elephant grass, demonstrating its positive response to an organic-rich growing medium. Conversely, pakchong grass exhibited reduced growth under high cow feces compost treatments. These findings underscore the importance of adjusting the composition of planting media based on the specific physiological characteristics of each grass species.*

Keywords: compost fertilizer, odot grass, elephant grass, pakchong grass, vegetative growth.

INTRODUCTION

Forage plays a crucial role in supporting the population growth of ruminants, thereby ensuring their survival and productivity (Muchlis *et al*., 2023). This aligns with the statement by Seseray *et al*. (2012), who noted that nearly 90% of the ruminant diet consists of forages, with daily fresh intake ranging from 10% to 15% of body weight, while the remainder is composed of concentrates and feed supplements. A rapid increase in livestock production can only be achieved through the provision of high-quality feed. High livestock productivity must be supported by an adequate supply of forage to meet nutritional requirements. As a key component of livestock diets, forage plays an essential role in maintaining animal health and productivity. High-quality forage improves digestibility, growth, and the production of milk or meat in ruminants (Rido & Erni, 2023). One of the key factors influencing forage productivity is the availability of nutrients in the soil.

Compost fertilizer serves as an important source of nutrients to support forage productivity. Compost derived from large livestock is rich in nitrogen and essential minerals such as magnesium, potassium, and calcium (Melsasail *et al*., 2018). According to Triansyah *et al.* (2018), compost from goat manure contains relatively high levels of macro-nutrients, including N at 2.43%, P at 1.35%, and K at 1.95%. Meanwhile, Lingga (1991) reported that compost made from cattle manure contains 80% moisture, 16% organic matter, 0.3% N, 0.2% P_2O_5, 0.15% K_2O, 0.2% CaO, and a C/N ratio of 20–25. These nutrients are essential for the growth of forage crops, and deficiencies may lead to suboptimal growth. According to Leiwakabessy *et al.,* (2004), nutrient deficiencies can impede plant growth and development, ultimately reducing crop productivity. Rakun *et al.,* (2018) also reported that variations in bokashi compost dosage had significant effects on plant height, leaf length, and leaf width. Therefore, appropriate and well-calibrated compost application is crucial for an optimal plant growth, whereas unsuitable application rates may hinder development (Novizan, 2005).

The forage species used in this study included odot grass (*Pennisetum purpureum* cv. Mott), elephant grass (*Pennisetum purpureum*), and pakchong grass (*Pennisetum purpureum* cv. Purple). Odot grass, also known as dwarf elephant grass (*Pennisetum purpureum* cv. Mott), is considered a superior forage species (Yowa & Sudarma, 2022). The three forage grass has strong roots, flexible stems, abundant leaf nodes, and a leaf structure that is easily consumed by livestock, making it highly palatable. Its crude protein content ranges between 10% and 15%, with relatively low crude fiber (Kaca *et al.,* 2019).

This study aims to evaluate differences in the growth characteristics of three forage grass species. Thus, it is essential to improve forage crop productivity through the application of cow feces compost at varying levels.

MATERIALS AND METHODS

Time and Location

c) Plant height (cm) is measuring the distance from the base of the stem (on the ground surface) to the highest part of the plant.

This research was conducted over a five weeks period, from October to November 2024. This research was conducted on the roof of the Integrated Laboratory Building of Sultan Ageng Tirtayasa University.

Tools and Materials

The tools used in this study included a caliper, ruler, hand shovel, watering can, scale, polybags, camera, and knife. The materials consisted of soil, cow faeces compost, rice husk charcoal, and stem cuttings of pakchong grass, elephant grass, and odot grass.

Experimental Procedures

The experimental procedure involved mixing soil, rice husk charcoal, and compost to create a planting medium. The planting was carried out in 40×40 cm polybags. Grass stem cuttings, each measuring 20 cm in length, were planted at a depth of 5 cm. The cuttings were inserted into pre-made holes and the surrounding soil was pressed firmly to ensure the cuttings remained stable and upright. Plants were watered twice daily, in the morning time 07.00-08.00 WIB and evening time 16.00-15.00 WIB, using mineral water. Observations were conducted weekly for a total duration of five weeks.

Observed Variables

The observed variables in this study included :

a) The number of leaves is measured by counting the total number of leaves in one sample plant with the criteria of leaves that have opened completely.
b) The number of tillers by counting the number of tillers that grow in each clump.

d) Stem diameter (mm) is done by measuring the middle part of the stem using a caliper.

Experimental Design and Data Analysis

The study employed a one-way Completely Randomized Design (CRD) with cow feces compost application level (P) as the treatment factor, consisting of four levels:

- P0 = soil + rice husk charcoal (control),
- P1 = 70% (soil + rice husk charcoal) + 30% cow feces compost,
- P2 = 50% (soil + rice husk charcoal) + 50% cow feces compost,
- P3 = 30% (soil + rice husk charcoal) + 70% cow feces compost.

Each treatment was replicated four times. The collected data were analyzed using Analysis of Variance (ANOVA) to determine the statistical significance of the treatments, followed by Tukey's Honest Significant Difference (HSD) test for pairwise comparisons among grass types.

RESULT AND DISCUSSION

Elephant grass contains approximately 8% to 12% crude protein. One of its main advantages is its rapid regrowth following cutting, which allows for year-round harvesting (Prasetyo, 2020). Pakchong grass is characterized by its impressive height, reaching up to 5 meters, and its adaptability to various environmental conditions. It also has a relatively high protein content, up to 16.45%, making it an excellent feed source for livestock with high protein requirements, such as dairy and beef cattle (Harianti *et al.*, 2023).

Table 1. Number of Leaves in Odot Grass, Elephant Grass, and Pakchong Grass.

Fertilization level	Number of leaves		
	Odot Grass	Elephant Grass	Pakchong Grass
P0	36.50 ±2.08	21.50 ± 1.73	25.00 ± 4.69
P1	39.25 ± 3.30	18.00 ± 10.42	24.75 ± 10.53
P2	48.75 ± 15.71	17.25 ± 7.93	12.50 ± 12.12
P3	44.25 ± 2.87	25.25 ± 10.71	19.75 ± 10.17

Note: P0 = Soil + rice husk charcoal, P1 = 70% (soil + rice husk charcoal) + 30% cow feces compost, P2 = 50% (soil + rice husk charcoal) + 50% cow feces compost, P3 = 30% (soil + rice husk charcoal) + 70% cow feces compost.

The results of the forage crop study indicated that there were no statistically significant ($P>0,05$) differences in the number of leaves among the three grass species across the four planting media treatments, which consisted of a combination of soil and rice husk charcoal with 0%, 30%, 50%, and 70% compost. Although there were variations in the average number of leaves among treatments, the high standard deviations suggest a considerable level of variability between individual plants. In general, the soil and rice husk charcoal medium provides good aeration and porosity, while compost contributes essential macro- and micronutrients for vegetative plant growth. The soil and rice husk charcoal medium provides good aeration and porosity due to the porous structure of rice husk charcoal, which enhances oxygen diffusion and water drainage (Habi & Kalay, 2021). Compost contributes essential macro- and micronutrients—such as nitrogen, phosphorus, and potassium—that are critical for cell division and vegetative growth (Melsasail *et al*., 2018; Triansyah *et al*., 2018). However, leaf number is influenced not only by nutrient availability, but also by genetic, physiological, and environmental adaptation factors. The absence of statistically significant differences in this study supports previous findings that forage species such as elephant grass and odot grass possess high tolerance to variations in planting media and are able to perform well under suboptimal conditions (Amaliah *et al.,* 2023).

Odot grass showed a tendency for increased leaf number with higher compost levels, although this trend was not consistent. In contrast, elephant and pakchong grasses exhibited fluctuating patterns. This inconsistency is presumed to be related to the differential adaptation of each grass species to nutrient availability and the physical characteristics of the growing medium. The high standard deviations, especially in the P1 and P2 treatments, indicate heterogeneous responses among individual plants within the same treatment group. This suggests that compost application does not necessarily produce uniform effects on early vegetative traits, particularly in terms of leaf production.

The practical implication of this finding is that the use of compost up to 70% does not provide significant (P>0,05) benefits compared to soil and rice husk charcoal alone, especially during the early growth stages observed in this study. However, Syafiyullah *et al.*, (2021) reported that the use of 45% urea fertilizer in rice plants increased parameters such as fresh biomass, leaf length, and improved nutritional quality.

Table 2. Number of Tillers in Odot Grass, Elephant Grass, and Pakchong Grass.

Fertilization level	Number of tillers		
	Odot Grass	Elephant Grass	Pakchong Grass
P0	7.50 ± 1.29	10.05 ± 5.96	4.00 ± 0.00^{b}
P1	8.25 ± 1.25	8.32 ± 3.72	3.50 ± 0.57^{ab}
P2	8.25 ± 2.21	9.62 ± 2.07	2.50 ± 1.00^{a}
P3	7.00 ± 0.81	12.77 ± 3.96	3.25 ± 0.50^{ab}

Note: Means in the same column/row with different superscript differ significantly (P <0.005). P0 = Soil + rice husk charcoal, P1 = 70% (soil + rice husk charcoal) + 30% cow feces compost, P2 = 50% (soil + rice husk charcoal) + 50% cow feces compost, P3 = 30% (soil + rice husk charcoal) + 70% cow feces compost.

Statistical analysis indicated that there were no significan (P>0,05) differences in the number of tillers in odot and elephant grass across treatments. However, in pakchong grass, a significant difference was observed at the 5% level (P<0.05). The highest average number of tillers in pakchong was recorded in treatment P0 (soil + rice husk charcoal), with 4.00 ± 0.00 tillers, while the lowest was observed in P2 (50% soil + rice husk charcoal + 50% compost) at 2.50 ± 1.00 tillers. This variation is likely due to the physical properties of the planting media, which affect aeration, moisture retention, and nutrient availability. In treatment P0, the dominance of rice husk charcoal in the media contributed to excellent porosity and drainage, promoting root system development and encouraging the emergence of lateral growth points (tillers). Conversely, in P2, the higher proportion of compost increased moisture retention and media density, potentially hindering root respiration and causing physiological stress in the plants. Additionally, residual ammonia content or incomplete compost decomposition may suppress vegetative growth, including tiller formation (Apriscia *et al.,* 2016).

Susanti *et al.,* (2024) reported that fertilization influences plant growth and productivity, including cellular respiration and photosynthesis activity. Nevertheless, nutrient balance and environmental conditions also play a crucial role in achieving optimal growth in pakchong grass. It is possible that the lower tiller number in P2 was influenced by physical changes in the planting medium, such as increased moisture retention and reduced porosity due to higher compost content, which may affect root respiration and nutrient uptake. High compost content without adequate soil structure support can lead to micro-anaerobic conditions in the root zone (Habi & Kalay, 2021). These findings imply that planting media based on soil and rice husk charcoal, with little or no compost addition, is more suitable for promoting tiller development in pakchong, particularly during the early growth phase. Media that are overly compact or waterlogged tend to inhibit tiller formation in sensitive species like pakchong, even though other grasses such as odot and elephant grass exhibited relatively stable growth. Therefore, cultivation strategies for pakchong should emphasize the balance between physical structure and organic content in the growing media to optimize tiller production as an indicator of forage vigor (Tjitrosoepomo, 2005; Widiastuti *et al.*, 2019).

Table 3. Plant Height of Odot Grass, Elephant Grass, and Pakchong Grass.

Fertilization level	Height of Plant		
	Odot Grass	Elephant Grass	Pakchong Grass
P0	16.77 ± 0.45	40.75 ± 21.50^{a}	15.25 ± 1.55^{b}
P1	16.52 ± 1.23	57.25 ± 17.67^{ab}	17.00 ± 1.08^{b}
P2	15.12 ± 0.25	63.37 ± 9.23^{ab}	15.50 ± 3.18^{b}
P3	14.40 ± 2.88	72.50 ± 7.54^{b}	11.75 ± 2.02^{a}

Note: Means in the same column/row with different superscript differ significantly (P <0.005). P0 = Soil + rice husk charcoal, P1 = 70% (soil + rice husk charcoal) + 30% cow feces compost, P2 = 50% (soil + rice husk charcoal) + 50% cow feces compost, P3 = 30% (soil + rice husk charcoal) + 70% cow feces compost.

Based on the analysis, odot grass did not exhibit significant differences (P>0,05) in plant height across treatments, whereas elephant grass and pakchong grass showed statistically significant differences (P<0.05). In elephant grass, the lowest average height was recorded under treatment P0 (40.75 ± 21.50 cm), followed by P1 and P2, while the highest height was observed under treatment P3 (72.50 ± 7.54 cm). These results indicate a positive response of elephant grass to increasing compost levels in the planting media. The gradual increase in elephant grass height with higher compost proportions suggests that this species is highly responsive to nutrient availability, particularly nitrogen, phosphorus, and potassium provided by organic matter (Yuri, 2021). Compost enhances soil structure, improves water retention, and enriches the media with beneficial soil microorganisms involved in nutrient cycling. The significant increase in height under P3 demonstrates that high compost content during the early growth phase supports stem elongation and vegetative development in elephant grass (Sariyanto *et al.*, 2018). This is reinforced by Lasamadi *et al.*, (2013) who conducted research on elephant grass stating that plant height reflects the role of essential nutrients such as N, P, K, and micronutrients contained in organic fertilizers.

In contrast, pakchong grass displayed an opposite trend to that of elephant grass. Treatment P3 resulted in the shortest average height (11.75 ± 2.02 cm), while the tallest plants were observed under P1 (17.00 ± 1.08 cm). Treatments P0 and P2 showed intermediate and relatively similar results. This pattern indicates that pakchong grass is more tolerant to media with lower compost content but experiences inhibited growth when compost levels are too high. This may be attributed to imbalances in moisture or restricted root respiration due to waterlogged and compacted media, which impairs stem growth (Widiastuti *et al.*, 2019). Additionally, this findsing may reflect the existence of an optimal threshold in compost application, as excessive amounts (e.g., in P3) can lead to a decline in plant height (Lasamadi *et al.*, 2013).

The contrasting responses of elephant and pakchong grasses suggest physiological differences and distinct growth requirements among grass species. Elephant grass appears to demand higher nutrient availability and performs better in organic-rich media, whereas pakchong grass prefers well-aerated media with moderate moisture levels. These findings align with the observations of Tjitrosoepomo (2005), who stated that optimal growth conditions vary depending on the species and the morphological adaptations of root and stem systems. Therefore, in practical forage cultivation, the composition of the growing media should be tailored to match the specific characteristics and requirements of each forage species.

Table 4. Stem Diameter of Odot Grass, Elephant Grass, and Pakchong Grass.

Fertilization level	Diameter of stem		
	Odot Grass	Elephant Grass	Pakchong Grass
P0	23.78 ± 4.38[bc]	14.27 ± 1.02ab	11.35 ± 2.97
P1	24.60 ± 1.17[c]	12.75 ± 1.26a	11.97 ± 3.03
P2	20.00 ± 1.54[ab]	13.72 ± 1.45ab	13.07 ± 4.06
P3	19.17 ± 1.69[a]	15.17 ± 0.75b	8.70 ± 1.54

Note: Means in the same column/row with different superscript differ significantly (P <0.005). P0 = Soil + rice husk charcoal, P1 = 70% (soil + rice husk charcoal) + 30% cow feces compost, P2 = 50% (soil + rice husk charcoal) + 50% cow feces compost, P3 = 30% (soil + rice husk charcoal) + 70% cow feces compost.

Statistical analysis showed that the stem diameters of odot and elephant grasses differed significantly among treatments (P<0.05), whereas pakchong grass did not show any significant differences. For odot grass, the highest average stem diameter was recorded in treatment P1 (24.60 ± 1.17 mm), followed by P0 and P2, while the lowest was observed in P3 (19.17 ± 1.69 mm). In contrast, elephant grass showed the largest stem diameter in P3 (15.17 ± 0.75 mm) and the smallest in P1 (12.75 ± 1.26 mm). These differences suggest that each grass species exhibits a specific response to planting media composition, particularly in terms of stem tissue development.

In odot grass, the application of 30% compost (P1) positively contributed to stem thickening. This aligns with the theory that nutrients in organic matter—particularly potassium and calcium—play a crucial role in strengthening cell walls and promoting the development of mechanical tissues in stems (Sutardi, 2010). However, in treatment P3 (70% compost), the denser media structure may have disrupted root respiration, thereby negatively affecting stem development (Astuti & Isworo, 2017). Conversely, elephant grass responded optimally under P3, which contained the highest compost proportion. This indicates that elephant grass is more adaptive to organic-rich media and can effectively utilize additional nutrients, including nitrogen and magnesium, which are essential for cell division and stem tissue development. This also reflects the physiological capacity of elephant grass to grow well in moist and fertile media (Tjitrosoepomo, 2005). Thus, for elephant grass, increasing compost content tends to promote stem enlargement up to an optimal level.

Meanwhile, the stem diameter of pakchong grass did not differ significantly (P>0,05) across treatments, ranging between 8.70 mm and 13.07 mm. This lack of significance may be attributed to high individual variability (as indicated by large standard deviations) and the physiological stability of pakchong in responding to different media conditions. This is consistent with previous research, which found that stem diameter is often more stable than plant height or number of tillers, particularly during early growth stages (Niklas & Spatz, 2004). Therefore, although planting media composition plays an important role, its effect on stem diameter in pakchong is less pronounced compared to odot and elephant grasses, suggesting that further studies during later growth stages may be necessary to detect potential differences.

CONCLUSION

In this study that the incorporation of compost into the planting media exerted varying effects on the vegetative growth of the three forage grass species examined. Elephant grass demonstrated the most positive response to compost application, particularly under the 70% compost treatment, which significantly enhanced plant height and stem diameter. The number of leaves across all three grass species did not differ significantly among treatments. In contrast, pakchong grass exhibited a decline in vegetative performance, especially in the number of tillers and plant height, when grown in media with high compost content.

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript. Conflicts of Interest should be stated in the manuscript.

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