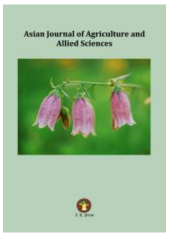

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Effect of Growing Crops and Rice Soil on Growth, Regeneration and Yield of Grass *Brachiaria humidicola* Grown in Central Vietnam

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ABSTRACT

B. humidicola grown in Thua Thien Hue province to provide food for the buffalo and cow breeding industry. The study was designed to experiment on 2 types of soils, soil growing crop and rice soil, of which 5 land slots with an area of 30m^2/plot were selected to grow the grass during the period from January 2021 to December 2022. Research results show that *B. humidicola* had high vitality, adaptability and growth through the rebirths of grass on the two kinds of soils, soil growing crops and rice soil in Thua Thien Hue province. The highest height of *B. humidicola* grass grown in the experiment was 73.66cm (batch 2) - 75.02cm (batch 1) on soil growing crops and 79.77cm (batch 3) - 81.36cm (batch 1) on rice soil. The grass lawn height was 44.79cm (batch 2) - 45.79cm (batch 1) for soil growing crops and 46.42cm (batch 3) - 47.93cm (batch 1) for rice soil. Number of branches/bush of various batches of *B. humidicola* was 40.05 branches/bush (batch 1) – 43.26 branches/bush (batch 3) for soil growing crops and 45.34 branches/bush (batch 2) - 48.30 branches/bush (batch 3) for rice soil. The regenerative capacity green matter yield (12.53 – 13.32 tons/ha/batch), dry matter yield (3.13 – 3.50 tons/ha/batch), protein yield (0.67 – 1.04

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tons/ha/batch) of *B. humidicola* grass grown in Thua Thien Hue were relatively high. This is an abundant source of food for the development of buffalo and cow husbandry.

Keywords: Brachiaria humidicola; batch; soil; yield.

1. INTRODUCTION

Cow husbandry is one of the agricultural production sectors that plays a very important role in the strategy of agricultural and rural economic development of many regions and the whole country. Cows are livestock closely associated with Vietnamese farmers from ancient times to the present. Cow husbandry takes advantage of local natural conditions for economic development, contributing to the enrichment of society. Cow husbandry provides meat, milk, traction, fertilizers for cultivation, raw materials for some handicrafts. Development of cow husbandry can create jobs, increase incomes and improve living conditions for farmers [1].

However, the biggest obstacle of the present cow husbandry industry is that the grazing land area is day by day shrinking due to various reasons, while cow farming still depends on natural grass, forage and nutrient-poor agricultural by-products. On the other hand, forage sources are imbalanced across seasons of the year, that is, an excess of green fodder in springs, a shortage of feed in cold dry winters and dry seasons. The current high-yielding intensive grass only meets about 10% of the forage demand for cattle [2]. Therefore, the cow farming industry faces difficulties in solving cow feed supply, as a result not developed commensurate with its potentials and advantages.

To solve the feed problem for the cow industry, one of the preferred solutions today is the policy of converting part of inefficient rice fields to grass fields to increase efficiency of agricultural production [3]. On the other hand, in recent years, the wet rice industry has faced many difficulties due to climate change, frequent natural disasters, droughts, floods, etc. Therefore, converting these wet rice fields to grass growing land is a beneficial alternative to make the most of the available land.

The Brachiaria grass group is native to the humid tropics of Africa. In our country, *B. humidicola* grass is a new species, which has strong and thriving roots, which allows for rapid improvement of soil porosity. *B. humidicola* grass can be planted with seeds or regenerated by branches, splitting clusters. The grass survives in many different types of soil such as acidic soils, poor soils with high pH and has suitable growth characteristics and adaptability to growing conditions on waterlogged lands [4]. Some provinces in our country have grown *B. humidicola* for cattle feed, typically in Binh Dinh, Phu Yen provinces, etc. which achieved high economic efficiency. However, in Thua Thien Hue province, B. *B. humidicola* grass has not been studied yet.

Thua Thien Hue has an area of agricultural production accounting for about 15.4% of natural land area, of which the land area for wet rice production accounts for more than 54%. Development of cow husbandry is strength of the province and is increasingly attracting investment. However, the cow feed problem is still facing many difficulties, suffering unfavorable climatic conditions of the province, drought in the hot summers and frequent prolonged floods (from September to November every year), plants die mainly due to waterlogging, so that there is no natural feed source for cows. Over the years, there have been many grass species such as VA06, TD58, etc grown to solve the problem of green feed for cows, but the efficiency is low due to the fact that these grass varieties that have poor waterlogging tolerance and cannot adapt to low-lying lands.

Stemming from the above-mentioned issues, the topic "Effect of soil quality and regeneration litter on growth and yield of grass *B. humidicola* grown in Thua Thien Hue province, Central Vietnam", propose solutions to improve the efficiency of cow grass cultivation at farmer households, develop production, contribute to raising their income.

2. MATERIALS AND METHODS

2.1 Research Site

The experiment was carried out (geographical coordinates: 16°29′07.4″N; 107°29′44.5″E) in the province of Thua Thien Hue from January 2021 to December 2022.

2.2 Experiment Design

The experiment was arranged completely randomly with two experiments corresponding to 2 different types of lands, namely soil growing crop and rice soil.

- Soil growing crop is land used for 1 rice crop and either one fresh produce crop cultivation or abandoned unused. Every year the land is flooded from September to the end of March of the following year, for the rest of the time it is dry.

- Rice soil is the land used for both Winter-Spring and Summer-Autumn rice cultivation seasons, the soil is completely low, the experimental field is flooded all year round about 20cm or more.

On each type of land, 5 field plots were selected to grow *B. humidicola*, with an area of $30m^2$/plot (5x6m). The time of planting, cutting, collecting and the regime of care and fertilization on these 10 field plots were all the same.

The soil in the experimental area was taken for sampling and analysis by diagonal method. Soil samples were taken at 5 spots from each slot, mixed well and sub-samples were taken for analysis.

2.3 Techniques for Planting, Caring and Harvesting

Soil preparation: The soil before planting was cleared out of weeds, thoroughly plowed, completely loosened, and fertilized with manure; land slots were allocated for experiment, and rows were made at intervals of 30 cm. When the soil was ready, planting started.

As for cuttings preparation, grass varieties were collected in the wild for segmental cutting, cuttings were taken 30 cm long from the root, corresponding to about 3-4 knots on the stem.

Planting technique: The grass was grown using cuttings, planted in rows, 30 cm apart, bushes 30 cm apart. 3 interlocking cuttings transplanted and inserted deep into the soil about 7-10 cm in rows, the root was about 30 cm from each other.

15-20 days after being planted, dead bushes were replaced; weeds were cleared twice before the grass completely covered the land. The first batch was harvested after being planted for 60 days. Following batches were harvested after every 40 days. The cuts were close to the root, 3-5 cm from the ground. After each harvest, fertilization, weeding, and top-dressing were done.

2.4 Monitoring Indicators

Time and sites of taking indicators: the indicators were monitored before first harvest which is 60 days after planting and following harvests which are 40 days old batches. On each slot, 5 points were selected according to the diagonal method for tracking indicators.

- *Height of the highest plant:* The height measured from the root of the plant (close to the ground) up to the growth point.

How to identify and measure plants: In each lot, the height of 5 tallest plants selected at the time of monitoring was measured. The distance was measured from the ground to the highest point by leaf stroking method.

- *Grass bed height:* In each lot, 5 random points on 2 diagonals of the lot were selected. A straight ruler was used to measure perpendicular to the ground, the height was measured from the ground to the point (or plane) where there are more than 70 percent of the leaves.

- *Green matter yield:* The entire amount of *B. humidicola* in the experiment slots, including withered branches were cut down, and weeds were removed. Cutting was done when it was not raining, all the dew had dried (about 5-10 cm from the ground), weight was scaled right after cutting on the experimental field to determine the volume of green matter on a plot and yield was calculated, from which can be converted into tons/ha/batch.

Green matter yield was converted into tons/ha/batch using the formula:

Green matter yield (tons/ha/batch) = kilograms of plants/m^2/ ×10,000 m^2/1000

- Dry matter yield: Dry matter yield = Green matter yield × % DM.

The DM ratio was determined by drying samples at a temperature of 105^0C until a constant mass to determine the percentage of dry matter.

- Protein yield: Protein yield = the dry matter yield × % of Protein present in DM.

2.5 Data Processing Method

The collected data was managed by Microsoft Excel software (2010) and processed by Minitab software version 19.0.

3. RESULTS AND DISCUSSION

3.1 Nutrient Characteristics of Soil at Test Sites

Soil analysis is a fundamental tool that allows us to determine soil nutrients essential to plants. Through soil analysis, it is clear whether the plant is nutrient deficient or poisoned by too high nutrient concentrations. Soil analysis is the basis for proper selection of crops and fertilization, improving nutritional conditions for crops to grow, develop, achieve high yields and good qualities.

The results of the analysis of nutrient characteristics of the soil at the experiment sites are shown in Table 1.

Table 1. Quality characteristics of soil at test sites

Parameters	Soil type	
	Soil growing crops	**Rice soil**
pH_{KCl}	4.65	4.5
Humus (%)	2.43	2.83
K_2O (%)	0.57	0.62
Nitrogen (%)	0.09	0.10
Phosphorus (%)	0.07	0.09
P (mg/100 g soil)	9.00	10.25
K (mg/100 g soil)	0.05	0.06
CEC (mg/100 g soil)	7.50	8.00

Soil quality analysis showed that in soil growing crops and rice crop soil are within the average nutrient limit, the soil has a slight acidity, suitable for growing rice and some other grasses and crops. The pH_{KCl} in soil growing crops was higher than in rice soil, specifically these indicators in soil growing crops were 4.65 and 4.5 in rice soil, respectively. The indicators for humus, K_2O, nitrogen, phosphate, P, K, CEC fertility were higher in growing crops soil than in rice soil (Table 1). This result showed that rice soil was richer in nutrients than growing crops soil.

pH acidity is one of the important factors determining soil fertility, affects physicochemical and biochemical processes in the soil and has considerable effects on crops. The experimental soil had a moderate pH acidity of 4.5 – 4.65 [5]. Most crops tolerate soils with a neutral to less acidic pH (pH = 6-7) except for a few crops that can tolerate acidic soils such as tea (pH 4.5-5.5), potatoes (pH 4.8-5.4).

Humus is an important indicator of soil fertility, determines the physical, chemical, biological properties of the soil. Humus is in soil <1%: very poor; 1-2%: poor; 2 – 3%: average; 3-5%: substantial; >5%: rich [5]. Through Table 1, we see that the humus in soil growing crops is 2.43% and in rice soil is 2.83%, which is average. When cultivating, we need to apply more manure to increase the humus of the soil.

In the life and growth of plants in general, nitrogen is the most important nutritional element, affecting the yield and quality of the plant. The amount of nitrogen in the soil is related to the humus of the soil. Nitrogen in experimental soil in soil growing crops is 0.09% and rice soil is 0.10%. This protein level is indicated nutrient-poor in the assessment frame (<0.1%: poor; 0.1-0.2%: average; >0.2%: rich) [5]. Therefore, in the process of cultivation, it is necessary to supply more nitrogen to the soil so that the crop achieves high yields.

The phosphate nutrient element is second only to the nitrogen element in the nutritional composition of plants. % of phosphorus analyzed in soil growing crops is 0.07% and rice soil is 0.09%, which is within the medium threshold (<0.03%: very poor; 0.03-0.06%: poor; 0.06-0.1%: average; >0.1%: rich) [5].

Potassium is a nutrient element second only to nitrogen and phosphate for plants. According to the analysis, the potassium content in soil growing crops is 0.05 (mg/100 g soil), in rice soil is 0.06 (mg/100 g soil) which is in an average range of 0.05 [5].

CEC fertility is the parameter reflecting the soil's ability to hold nutrients. CEC depends on 2 indicators: content and property of humus and clay grain grade. CEC in soil growing crops was 7.5 (mg/100g soil) and rice soil was 8.00 (mg/100g soil). This indicator in the experimental soil was in low range (<10: low; 10-20: medium; >20: high) [5].

Thus, we found that both types of soil in the experiment have average nutritional value, low ability to hold nutrients, and medium acidic soil. Therefore, in the process of cultivation, we should not forget to apply more manure and chemical fertilizers as well as improve the acidity of the soil with lime to achieve high yields.

3.2 *Brachiaria humidicola*’s Growth/ Regeneration on Different Soils

3.2.1 Tallest plant height

The height regeneration capacity of *B. humidicola* plants grown in experiments is shown in Table 2.

The ability to regenerate plant height through 4 batches on each soil type was almost the same.

The results of monitoring the growth and regeneration of plant height through 4 batches in soil growing crops were 75.02 ± 2.47; 73.66 ± 3.56; 74.50 ± 3.37 and 74.69 ± 2.46 cm, respectively and rice soil 81.36 ± 3.16; 80.46 ± 3.62; 79.77 ± 3.30 and 80.65 ± 2.49 cm, respectively (Table 2). This result shows that the height regeneration of *B. humidicola* grass was relatively uniform, less fluctuating than *B. mutica.* Specifically, according to the research by Phung, et al. (2021), measured at 30 days after planting and 30 days after each harvest, batches 1 to 4 of *B. mutica* reached heights of 78.3 ± 17.7; 73.3 ± 20.2; 74.3 ± 3.3 and 79.6 ± 2.9 [6].

3.2.2 Lawn height

The height of the regenerated grass decreased after each harvest but the decrease was not significant, the regeneration in batch 4 was higher than batches 2 and 3. The regeneration of the height of the lawn through 4 batches of soil growing crops was 45.79 ± 1.38; 44.79 ± 1.79; 45.65 ± 2.19 and 45.37 ± 1.86 cm, respectively, while in rice soil 47.93 ± 1.40; 46.79 ± 2.43; 46.42 ± 2.29 and 47.50 ± 2.03 cm, respectively. The regeneration capacity in lawn height in rice soil and soil growing crops tended to decrease after each harvest, but the level of decrease is not significant, the height of regenerated lawn in rice soil was higher than soil growing crops.

3.2.3 Number of branches/bushes

The regeneration of branches/bush of 4 batches on soil growing crops was 40.05 ± 4.08; 41.63 ± 3.89; 43.26 ± 2.69 and 43.13 ± 0.71 cm, respectively, while on rice soil 45.71 ± 3.38; 45.34 ± 3.15; 48.30 ± 2.12 and 48.06 ± 1.70 cm, respectively. The ability to regenerate branches/bush on rice soil and soil growing crops tended to increase after each harvest, the ability to regenerate grass on rice soil was higher than soil growing crops after each harvest.

Table 2. The tallest plant height of different batches of *B. humidicola* grass on different soils (cm)

Soil types / Growth indicators	Soil growing crops M ± SE	Rice soil M ± SE	*t*	*P*
From planting to 40 days - Batch 1	75.02 ± 2.47	81.36 ± 3.16	-1.583	0.152
After 1st harvest to 40 days - Batch 2	73.66 ± 3.56	80.46 ± 3.62	-1.341	0.217
After 2nd harvest to 40 days - Batch 3	74.50 ± 3.37	79.77 ± 3.30	-1.118	0.296
After 3rd harvest to 40 days - Batch 4	74.69 ± 2.46	80.65 ± 2.49	-1.703	0.127
F	0.04	0.04		
P	0.990	1.00		

Table 3. The height of different batches of *Brachiaria humidocola* in different soils (cm)

Soil types / Growth indicators	Soil growing crops M ± SE	Rice soil M ± SE	*t*	*P*
From planting to 40 days - Batch 1	45.79 ± 1.38	47.93 ± 1.40	-1.087	0.309
After 1st harvest to 40 days - Batch 2	44.79 ± 1.79	46.79 ± 2.43	-0.67	0.53
After 2nd harvest to 40 days - Batch 3	45.65 ± 2.19	46.42 ± 2.29	-0.24	0.81
After 3rd harvest to 40 days - Batch 4	45.37 ± 1.86	47.50 ± 2.03	-0.78	0.46
F	0.06	0.11		
P	0.98	0.95		

Table 4. Number of branches/bush of various batches of *Brachiaria humidicola* on different soils (cm)

Growth indicators \ Soil types	Soil growing crops (M ± SE)	Rice soil (M ± SE)	*t*	*P*
From planting to 40 days - Batch 1	40.05 ± 4.08	45.71 ± 3.38	-5.664	0.316
After 1st harvest to 40 days - Batch 2	41.63 ± 3.89	45.34 ± 3.15	-0.740	0.480
After 2nd harvest to 40 days - Batch 3	43.26 ± 2.69	48.30 ± 2.12	-1.474	0.179
After 3rd harvest to 40 days - Batch 4	43.13 ± 0.71	48.06 ± 1.70	-2.682	0.028
F	0.229	0.332		
P	0.875	0.803		

According to Phan, et al (2020), it is highly recommended that the number of branches/bushes of elephant grasses vary greatly across cuttings [7].

3.3 Productivity of Experimented Grass

Green matter yield, dry matter yield and protein yield of grass are important foundations for assessing the plant production potential, thereby forming development strategies in animal husbandry. Average green matter yield, dry matter yield and protein yield of postharvest regenerated *B. humidicola* were as follows Table 5.

3.3.1 Green matter yield

It is noticeable that the Green matter yield generally exhibits a slight decrease from the initial planting (Batch 1) to subsequent time periods for both soil types. This could indicate a gradual reduction in vegetative growth over time. Additionally, the Rice soil consistently demonstrates higher Green matter yield compared to Soil growing crops across all time periods, suggesting its potential to support better plant growth in terms of biomass (Table 5).

According to Ho et al. [8], grass ghine and Mulato II have variation across different cuttings; grass ghine of batch 1, 2, 3 and 4 respectively 3.09, 3.68, 3.91 and 3.46 tons/ha/batch; grass Mulato II of batch 1, 2, 3 and 4 respectively 3.65, 3.99, 4.35 and 3.86 tons/ha/batch. Grass *S. guianensis* CIAT 184 respectively 10.6 tons/ha batch 6 and 33.7 tons/ha was batch 1 [9].

This result shows that the green matter yield of *B. humidicola* in the experiment was higher than in other studies on *B. humidicola* grass and other grasses. Specifically: according to Nguyen et al. [10], *Brachiaria* has a green matter yield of 116.8 – 170.8 tons/ha/year, Ghine grass 151.9 – 167.3 tons/ha/year, Stylo grass 81.6 – 107.9 tons/ha/year. *B. humidicola* grown in Quang Binh has an average green matter yield of 8.67 – 13.8 tons/ha/batch for 1-crop soil and 12.28-29.87 tons/ha/batch for 2-crop soil [11]. According

Table 5. Green matter yield, dry matter yield and protein yield of different batches of *B. humidicola* (tons/ha/batch)

Parameters \ Soil type	Green matter yield (M ± SE)		Dry matter yield (M ± SE)		Protein yield (M ± SE)	
	Soil growing crops	Rice soil	Soil growing crops	Rice soil	Soil growing crops	Rice soil
From planting to 40 days - Batch 1	12.53 ± 1.22	14.25 ± 1.58	3.23 ± 0.31	3.98 ± 0.42	0.67 ± 0.17[b]	0.72 ± 0.17[b]
After 1st harvest to 40 days - Batch 2	13.32 ± 0.80	15.14 ± 0.95	3.42 ± 0.17	4.01 ± 0.21	1.04 ± 0.03[a]	1.25 ± 0.03[a]
After 2nd harvest to 40 days - Batch 3	13.07 ± 0.65	13.86 ± 0.63	3.50 ± 0.21	3.95 ± 0.15	0.96 ± 0.05[ab]	0.98 ± 0.05[ab]
After 3rd harvest to 40 days - Batch 4	12.69 ± 0.54	13.75 ± 0.27	3.13 ± 0.13	3.62 ± 0.19	0.91 ± 0.04[ab]	0.93 ± 0.04[ab]
F	0.18	0.25	0.593	0.27	3.263	5.697
P	0.91	0.86	0.629	0.56	0.049	0.047

The values in the column represent the mean and error. Letters in the same column represent the difference between experimental formulas by single-factor variance analysis and the Turkish test to Le et al. (2012), the green matter yield of *B. ruziziensis* is 6.2 – 8 tons/ha/batch; *B. decumbens* is 10.4 – 13.5 tons/ha/batch and *B. brizantha* is 10.5 – 13.1 tons/ha/batch [2]. The studies show green matter yield of some herbaceous grass varieties: *B. Mulato II* grass is 38.81 tons/ha/batch, legumes are 4.33 – 31.17 tons/ha/batch [12]; *Brachiaria* (*B. ruzi, B. dcumben, B. brizantha, B. mulato, B. setaria, B. multica)* is 116.8 – 170.8 tons/ha/year, Ghine grass 151.9 – 167.3 tons/ha/year, stylo grass 81.6 – 109.2 tons/ha/year [13]. According to the research by Nguyen, et al. (2011), *Paspalum* at various planting distances has a green matter yield of 16.64 – 26.56 tons/ha, dry matter 4.05 – 6.26 tons/ha, protein 0.32 – 0.62 tons/ha [14]. According to the research results of Nguyen, et al. (2010), the average green matter yield (8 batches/year) for large-leaved lemongrass, small-leaved lemongrass, *Paspalum atratum*, *Setaria* grass is: 61.0 – 91.3; 72.7 – 90.0; 142.3 – 184.7; 63.2 – 95.0; 106.3 – 168.0 tons/ha/year, respectively [15].

3.3.2 Dry matter yield

The Dry matter yield follows a similar trend, with a gradual decrease over successive time periods. Interestingly, the difference in Dry matter yield between the two soil types appears to diminish over time, as the initial advantage of Rice soil in this aspect becomes less pronounced (Table 5).

According to the research results of Nguyen et al. (2008), the dry matter yield of *Brachiaria* grass group *(B. ruzi, B. dcumben, B. brizantha, B. mulato, B. setaria, B. multica)* is 18.6 – 34.0 tons/ha/year, *Ghine* grass 24.1 – 25.5 tons/ha/year, *Stylo* grass 11.5 – 17.0 tons/ha/year [13]. The survey results of Nguyen, et al. (2010) shows that the average dry matter yield (8 batches/year) for large-leaved lemongrass, small leaf lemongrass, *Paspalum atratum*, *Setaria* grass are: 12.1 - 18.1, 17.7 - 22.1, 30.7 - 39.9, 10.0 - 15.1, 18.3 - 28.9 tons/ha/year, respectively [15].

3.3.3 Protein yield

The Protein yield displays a fluctuating pattern. While the Rice soil initially yields notably higher protein in the first two batches, the Soil growing crops catch up and even surpass the Rice soil in the last two batches. This variation could be attributed to complex interactions between soil type, plant growth stages, and nutrient availability.

The statistical analysis, indicated by the F and P values, suggests varying degrees of significance in differences among the parameters and soil types. The lower p-values (e.g., 0.047 for Protein yield in Rice soil) could signify statistically significant variations, warranting further investigation (Table 5).

In animal husbandry, protein is an important component that increases the biological value of feed and provides amino acids for the growth and development of cattle, increasing livestock productivity. Crude protein yield is calculated by dry matter yield and protein ratio. The protein yields of four batches of *B. humidicola* in the experiment were: on 1-crop soil 0.67 ± 0.17^{b}; 1.04 ± 0.03^{a}; 0.96 ± 0.05^{ab} and 0.91 ± 0.04^{ab} tons/ha/batch, respectively (Table 5). Thereby, we see that the protein yield of *B. humidicola* grown batch 2 was higher than that batch 1 (p<0,05).

According to the research results of Nguyen (2017), the average protein yield of *B. humidicola* on 1-crop soil is 0.68 - 1.46 tons/ha/batch and 2-crop soil is 0.92 - 2.43 tons/ha/batch [11]. Therefore, *B. humidicola* in the experiment had a high protein yield.

The purpose of intensive grass cultivation is pastures with higher yield per area unit compared with other crops. Because *B. humidicola* in the experiment had a high green matter yield, high dry matter yield and high protein yield, this is an abundant source of food for the development of buffalo and cow husbandry.

4. CONCLUSIONS

B. humidicola had high vitality, adaptability and growth through the rebirths of grass on the two kinds of soils, soil growing crops and rice soil in Thua Thien Hue province. The highest height of *B. humidicola* grass grown in the experiment was 73.66cm (batch 2) - 75.02cm (batch 1) on soil growing crops and 79.77 cm (batch 3) - 81.36cm (batch 1) on rice soil. The grass lawn height was 44.79cm (batch 2) - 45.79cm (batch 1) for soil growing crops and 46.42cm (batch 3) - 47.93cm (batch 1) for rice soil. Number of branches/bush of various batches of *B. humidicola* was 40.05 branches/bush (batch 1) – 43.26 branches/bush (batch 3) for soil growing crops and 45.34

branches/bush (batch 2) - 48.30 branches/bush (batch 3) for rice soil.

The regenerative capacity green matter yield (12.53 – 13.32 tons/ha/batch), dry matter yield (3.13 – 3.50 tons/ha/batch), protein yield (0.67 – 1.04 tons/ha/batch) of *B. humidicola* grass grown in Thua Thien Hue were relatively high. This is an abundant source of food for the development of buffalo and cow husbandry.

The observed trends and variations provide valuable insights for optimizing agricultural practices and crop management strategies, indicating that both soil type and the stage of growth significantly impact the outcomes. Further research could delve into specific factors influencing these trends, potentially leading to enhanced crop production and agricultural sustainability.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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