Hue University Journal of Science: Natural Science
Vol. 133, No. 1B, 13–22, 2024

pISSN 1859-1388
eISSN 2615-9678

Effects of planting densities and regenerations on the growth and yield of *Brachiaria humidicola* grown in Thua Thien Hue province

Bui Van Loi*

Hue University, 03 Le Loi St., Hue, Vietnam

* Correspondence to Bui Van Loi <bvloi@hueuni.edu.vn>

(*Received: 22 April 2024; Revised: 11 May 2024; Accepted: 21 May 2024*)

Abstract. *Brachiaria humidicola* is a new grass grown for cattle feed. In this study, experiments were conducted in Thua Thien Hue province, including four treatments with four planting densities of 10 x 10 cm, 20 x 20 cm, 30 x 30 cm, and 40 x 40 cm through three regenerations. The first regeneration was 60 days old, and the next two regenerations were 40 days each from the previous harvests. The experiment aimed to evaluate the effect of planting densities and regenerations on the growth and yield of *B. humidicola*. The results showed that the tree height, grass bed height, and number of branches/tussock varied significantly between planting densities ($p < 0.05$), with the highest values observed at the planting density of 30 x 30 cm (96.33 cm, 73.38 cm and 40.17 branches/tussock, respectively). The fresh matter yield, dry matter yield, and protein yield of *B. humidicola* also showed significant differences ($p < 0.05$), achieving the highest values at the planting density of 30 x 30 cm (13.87, 3.69 and 0.97 tons/ha/generation, respectively). In general, the best growth and yield of *B. humidicola* were maximized through regenerations at the planting densities of 30 x 30 cm.

Keywords: *Brachiaria humidicola*, planting distance, regeneration, growth, yield

1 Introduction

Cattle farming is an agricultural sector that plays an important role in the rural and agricultural economic development strategies of provinces. It allows exploiting the advantages of local natural conditions for economic development, and the prosperity of the society. However, the cattle farming industry is currently facing substantial difficulties, particularly a serious shortage of forage sources due to the reduction of grazing land, natural pastures. Feed for cattle mainly consists of forage plants and low-nutrition agricultural by-products. As a result, cattle farming has not developed commensurately with it potentials and strengths of the industry.

Thua Thien Hue province has an agricultural production area accounting for 13.9% of its natural land area, of which the land area for wet rice production accounts for more than 54% [1]. The development of cattle farming is a potential area which has attracted increasing investment from local authority. However, like other provinces, feed for cattle remains problematic. Farmers can not ensure a sufficient feed supply, especially due to the province's climatic conditions, which include prolonged heat in the summer causing drought, dried-out plants, and prolonged floods in the winter causing waterlogged plants. In recent years, Thua Thien Hue province has introduced many grass varieties but their efficiency and effectiveness have been low due to poor inundation tolerance, and unsuitability for low-land areas.

B. humidicola has strong and thriving roots, enabling rapid improvement of soil porosity. The

grass survives in a variety of soils such as acidic, poor, infertile, and high-pH soils, and has suitable growth characteristics and adaptability to growing conditions on waterlogged lands. Several provinces in Vietnam have grown *B. humidicola* for cattle feed, which initially proved high economic efficiency such as Quang Binh province [2]. In Thua Thien Hue province, *B. humidicola* was introduced for trial cultivation in 2016. The grass has better adaptability and resistance to waterlogging conditions compared to other grass varieties [3]. However, planting methods and techniques have not been researched.

Therefore, the research "*Effects of planting densities and regenerations on the growth and yield of Brachiaria humidicola grown in Thua Thien Hue*" aims to determine the best planting densities and regeneration ability of the grass to improve growth, yield, and the effectiveness of growing grass for cattle feed by farming households.

2 Research materials and methods

2.1 Research materials

B. humidicola is a species of a herbaceous flowering genus in the Poaceae family. The classification of the species is as follows: *Kingdom (regnum): Plantae; Order (ordo): Poales; Family (familia): Poaceae; Genus: Brachiaria; Species: Brachiaria humidicola; Synonym: Urochloa humidicola.*

B. humidicola was brought from Phu Yen province to be experimentally grown as cattle feed in Thua Thien Hue province.

2.2 Research location

The grass planting experiment was conducted in rice fields in Thuy Van ward, Hue city, Thua Thien Hue province.

Grass samples were analyzed for chemical composition (dry matter, protein) at: Laboratory of the Faculty of Animal Husbandry and Veterinary Medicine, University of Agriculture and Forestry and Faculty of Biology, University of Education, Hue University.

Soil samples were analyzed at the Laboratory of the Faculty of Agronomy, University of Agriculture and Forestry, Hue University.

2.3 Research content and methods

Experimental design

The experiment was designed completely at random with 04 treatments corresponding to 04 planting distances and 04 replicates. The area for each treatment was 30 m^2 (5 m x 6 m).

Treatment 1: planting distance 10 x 10 cm;

Treatment 2: planting distance 20 x 20 cm;

Treatment 3: planting distance 30 x 30 cm;

Treatment 4: planting distance 40 x 40 cm.

The soil in the experiment was the rice field soil used for both winter-spring and summer-autumn crops. The entire soil area was low-lying and flooded about 20 cm high or more all year round, up to 30 - 50 cm high during heavy rains.

B. humidicola was planted in the field. The timing for planting, collecting and caring for and fertilizing the grass in 04 field plots was the same (fertilized with manure in the amount of 10 tons/ha).

Samples of the soil in the experimental area (5 plot) was collected for analysis using the diagonal method. Soil in each plot was taken at 5 points, and soil samples from each treatment were mixed well and sub-samples were taken for analysis.

pISSN 1859-1388
eISSN 2615-9678

Table 1. Soil characterisitics

Indicators	pH KCl	OM (%)	K2O %	N %	P2O5 %	P2O5 (mg/ 100g)	K2O (mg/ 100g)	CEC (cmolc/ kg)	H+ (meq/ 100g)	Al3+ (meq 100)
Value	4.6	2.6	0.6	0.1	0.1	9.6	0.1	8.3	1.0	1.1

Techniques for planting, caring for and harvesting

Soil preparation: Before planting, the soil was cleared of weeds, plowed thoroughly, and fertilized with manure in the amount of 10 tons/ha. The soil's mud content was ensured, and experimental plots were allocated. After soil preparation was done, the grass was planted at predetermined distances.

Preparation of cuttings: *B humidicola* were collected in the wild for segmentation, 30cm long cuttings were taken from the root, having approximately 3 - 4 nodes on the stem.

Planting technique: The grass is grown by cuttings, and planted in rows, at the distance according to 04 experimental designs (10 x 10 cm, 20 x 20 cm, 30 x 30 cm and 40 x 40 cm). Three cuttings were interlocked and buried at about 7 - 10 cm deep into the soil, in predetermined rows and positions.

After 15-20 days, dead grass was replaced by new cuttings. Weeds were cleared twice before the grass fully covered the soil. A protective fence was set up around the area to prevent cattle from entering and grazing the grass.

Harvesting: after being planted for 60 days, the first batch was collected (Batch 1). Subsequent batches were 40 days apart. The grass was cut close to the root, 3 - 5 cm from the ground. After each harvest, fertilizing and weed clearing were performe.

Monitoring indicators and methods

Time and sites of taking indicators: Indicators were monitored before the first harvest, which was 60 days after planting, and at following harvests at 40-day intervals. In each slot, 5 points (cells) were selected using the diagonal method for tracking indicators.

Methods of soil analysis include: Soil acidity (pH) analyzed according to TCVN 5979:2007; OM: calculated as organic carbon (OC) x 1.724; N (%): analyzed according to TCVN 8498:1999; P_2O_5 (%) analyzed according to ISO 8940:2011 standard; K_2O (%) according to ISO 8660:2011

Height of the highest plant: The height of 5 tallest trees at each cell (01 x 01 m) was measured from the base of the stem (right at the soil surface) to the top of the canopy (the highest part of the plant) using a direct measurement method.

Grass bed height: In each lot, 5 random points on 2 diagonals of the plot were selected. A straight ruler was used to measure perpendicularly to the ground, the height was measured from the ground to the point (or plane) where more than 70% of the leaves could reach.

Number of branches/tussock: all branches/tussock in 5 selected locations were counted. Counted branches consisted of both new branches that just grew from the stems and existing ones that continued growing.

Fresh matter yield: The entire amount of *B. Humidicola* in the experiment plots, including withered branches, was 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). The weight was scaled immediately after cutting in the experimental field to determine the volume of green matter per plot. The yield was calculated and converted into tons/ha/batch, using the following formula:

Green matter yield (tons/ha/batch) = kilograms of plants/m²/ ×10,000 m²/1000

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

The DM ratio was determined by drying samples at 105⁰C until a constant mass was obtained.

Protein composition was analyzed according to the method of AOAC (1990).

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

Data management and processing

The collected data was managed using Microsoft Excel and processed using Minitab software version 19.0.

3 Research findings and discussion

3.1 Growth ability of *Brachiaria humidicola* in correlation with planting distances

Height of tallest plant

To assess the growth and development of plants, many indicators can be used, among which plant height is an important factor. The taller the plant, the greater the green matter yield. The results of the study showed the tallest tree height of *Brachiaria humidicola* in different regeneration batches planted at various distances in Thua Thien Hue province, averaged and shown in Table 2.

Table 2. Effect of planting distance on tallest plant height (cm)

Regenerations	Planting distances				SEM	P
	10 x 10 cm	20 x 20 cm	30 x 30 cm	40 x 40 cm		
Average	76.87^{A}	85.63^{B}	96.33^{C}	95.47^{C}	0.886	0.000
Batch 1	80.84^{a}	86.68	97.16	98.04^{a}		
Batch 2	77.80^{a}	83.72	96.52	95.20^{ab}		
Batch 3	71.98^{b}	86.48	95.32	93.16^{b}		
SEM	1.686	1.258	1.560	1.411		
p	0.002	0.185	0.700	0.045		

SEM: Standard Error of the Mean. A, B, C in the same row and a, b, c in the same column, numbers with different exponent letters are statistically significantly different (p < 0.05).

Table 2 shows that *B. humidicola* had a relatively positive plant height compared to other Poaceae family plants (76.87 - 96.33 cm), which were statistically different across different planting distances, lowest at planting distance 10 x 10 cm (76.87 cm) and highest at planting distance 30 x 30 cm (96.33 cm) ($p < 0.05$).

Regenerations also affected the plant height of *B. humidicola,* showing a decreasing tendency through regenerations (except for the 3rd batch at a planting distance of 20 x 20 cm). The highest plant heights were observed in the first batch, likely because the first batch had newly planted grass which had better growth and a longer growing period until harvest (60 days).

pISSN 1859-1388
eISSN 2615-9678

According to the research results of Nguyen Thi Hong Nhan et al. [4] planting distances and regenerations had an effect on the height of *Paspalum atratum*, with the optimal height being 94.38 cm in the 3rd batch at a planting distance of 20 x 50 cm. Some research results on the growth ability of herbaceous species showed that the height of *B. brizantha* grass was 76.00 cm, *Mulato II* grass was 75.60 cm and *Panicum maxinum* TD58 grass was 80.2 cm [5]. The research by Phan Thi Hong Nhung et al. [6], on the height of *Ghine* grass, *Ruzi* grass, and by Ho Van Trong et al. [7] on the height of *Ghine* grass yielded similar results.

Grass bed height

The grass bed height reflects the uniform growth and the yield of the grass. The height of *B. humidicola* planted in the experiment across planting distances and batches is shown in Table 3.

Table 3. Effect of planting distance on grass bed height (cm)

Regenerations	Planting distances				SEM	P
	10 x 10 cm	20 x 20 cm	30 x 30 cm	40 x 40 cm		
Average	62.79^{A}	66.85^{B}	73.38^{C}	71.55^{C}	0.837	0.000
Batch 1	60.21^{a}	61.87^{a}	72.20	65.42^{a}		
Batch 2	68.18^{b}	71.68^{b}	74.15	75.51^{b}		
Batch 3	59.98^{a}	66.99^{c}	73.80	74.62^{b}		
SEM	1.397	1.222	1.108	1.343		
p	0.000	0.000	0.417	0.000		

SEM: Standard Error of the Mean. A, B, C in the same row and a, b, c in the same column, numbers with different exponent letters are statistically significantly different ($p < 0.05$).

Data from Table 3 shows that the grass bed height varied across planting distances. The wider the planting distance, the higher the grass bed height, with the highest being 73.38 cm at the planting distance of 30 x 30 cm ($p < 0.05$). Although the grass bed at the planting distance of 40 x 40 cm was lower than at the distance of 30 x 30 cm, this difference is not statistically significant. When the spacing was too large, the grass tended to crawl on the ground rather than rise high to get sunlight.

The grass bed height at different planting distances through regenerations varied and was statistically significantly different (except at a planting distance of 40 x 40 cm) ($p < 0.05$).

The bed height of *S. guianensis* CIAT 184 was 68.5 cm [8]; *Ghine* TD58 grass at 40 days of age was 48.55 cm and at 60 days of age was 88.33 cm [9]. According to the research results of Le Dong Xuan et al. [10], the grass height depended on the amount of fertilizer, *B. ruziziensis* was 50 ± 3.0 – 56 ± 56.40 cm; *B. decumbens* was 45 ± 2.5 – 46 ± 4.0 cm; *B. brizantha* was 57 ± 4.0 – 65.40 ± 4.0 cm. The research by Nguyen Xuan Ba et al. [11] showed that the grass height depended on soil types, large-leaved Mombasa Guinea TD 58 was 56.5 ± 1.4 - 70.2 ± 1.7 cm; small-leaved Tanzania Guinea is 42.1 ± 0.3 – 59.0 ± 0.5 cm; *Ruzi* was 50.7 ± 0.5 – 77.6 ± 2.2 cm and *Paspalum atratum* was 37.3 ± 0.3 – 57.2 ± 10.8 cm.

Number of branches/tussock

The number of branches/tussock of *B. humidicola* planted at different distances and regenerations is shown in Table 4.

Table 4. Effect of planting distances on the number of branches/tussock

Regenerations	Planting distances				SEM	p
	10 x 10 cm	20 x 20 cm	30 x 30 cm	40 x 40 cm		
Average	10.659^{A}	24.88^{B}	40.17^{C}	36.48^{C}	0.050	0.000
Batch 1	10.52	23.96	34.68^{a}	28.20^{a}		
Batch 2	11.00	24.80	45.36^{b}	42.76^{b}		
Batch 3	10.44	25.88	40.48^{ab}	38.48^{b}		
SEM	0.542	1.423	2.155	2.084		
p	0.765	1.000	0.003	0.000		

SEM: Standard Error of the Mean. A, B, C in the same row and a, b, c in the same column, numbers with different exponent letters are statistically significantly different (p < 0.05).

The number of branches/tussock of *B. humidicola* varied greatly across planting distances, with the planting distance of 30 x 30 cm having the highest average number of branches/tussock of 40.17 branches/tussock ($p < 0.05$) (Table 4).

The number of branches/tussock through 3 batches at planting distances of 10 x 10 cm and 20 x 20 cm was relatively stable which was not statistically different ($P<0.05$). In contrast, at two other planting distances of 30 x 30 cm and 40 x 40 cm there was a statistically significant difference ($p < 0.05$). Through cuttings, the number of branches/tussock of grass had a tendency to increase (Table 4), likely because after cuttings, auxin's apical dominance and auxin/cytokinin ratio decreased, apical growth dominance was inhibited, subtending lateral buds grew more abundantly.

According to the research results of Nguyen Thi Hong Nhan et al. [4], planting distances affected the number of *Paspalum atratum* buds/bush, which was highest at the distance of 50 x 50 cm and lowest at the distance of 20 x 50 cm. Previous studies showed that the number of branches/tussock of *B. brizantha* was 20.2, *Mulato II* was 27.3 and *Panicum maxinum* TD58 was 13.4 [5].

In short, based on the above analysis, among the 04 planting distances, the distance of 30 x 30 cm produced optimal plant height, grass bed height and number of branches/tussock ($p < 0.05$). The growth through regenerations varied, but was still within the normal growth range of the varieties.

3.2 Yield of *Brachiaria humidicola* planted at different distances

Fresh matter yield

The green matter yield of *B. humidicola* planted at different distances and through regenerations is shown in Table 5.

The results in Table 5 show that the green matter yield of *B. humidicola* at different planting distances had a statistically significant difference, the highest yield was 13.87 tons/ha/batch at the planting distance of 30 x 30 cm ($p < 0.05$).

Among different regenerations, green matter yield fluctuated through planting distances ($p < 0.05$). At the planting distance of 30 x 30 cm, the yield of all 3 batches was highest compared to other planting distances (Table 5.

pISSN 1859-1388
eISSN 2615-9678

Table 5. Effect of planting distances on green matter yield (tons/ha/batch)

Regenerations	Planting distances				SEM	p
	10 x 10 cm	20 x 20 cm	30 x 30 cm	40 x 40 cm		
Average	10.01^{A}	12.89^{B}	13.87^{C}	10.12^{A}	0.247	0.000
Batch 1	9.48^{a}	10.90^{a}	11.93^{a}	9.21^{a}		
Batch 2	10.93^{b}	14.20^{b}	15.03^{b}	10.50^{b}		
Batch 3	9.62^{a}	13.58^{b}	14.65^{b}	10.65^{b}		
SEM	1.384	1.242	0.407	0.288		
p	0.007	0.000	0.000	0.001		

SEM: Standard Error of the Mean. A, B, C in the same row and a, b, c in the same column, numbers with different exponent letters are statistically significantly different ($p < 0.05$).

B. humidicola grown in Quang Binh produced an average green matter yield of 8.67 – 13.8 tons/ha/batch on 1-crop soil and 12.28-29.87 tons/ha/batch on 2-crop soil [2]. According to Le Xuan Dong et al. [10], the green matter yield of *B. ruziziensis* was 6.2 – 8 tons/ha/batch; *B. decumbens* was 10.4 – 13.5 tons/ha/batch and *B. brizantha* was 10.5-13.1 tons/ha/batch. According to Ho Van Trong et al. [7], the green matter yield of *Ghine* was 3.36 tons/ha/batch and *Mulato II* was 3.97 tons/ha/batch.

The studies presented the green matter yield of some varieties of Poaceae family: *S. guianensis* CIAT 184 was 19.46 tons/ha/batch [8]; *Paspalum* at different planting distances had a green matter yield of 16.64 – 26.56 tons/ha [4]; The green matter yield of *Paspalum atratum* was 8.20 – 41.10 tons/ha/batch and *Stylosanthes* was 19.5 – 29.5 tons/ha/batch depending on fertilizer regime [12].

Dry matter yield

Determining the dry matter yield of grass is an important indicator for assessing its productivity. The average dry matter yield of *B. humidicola* at different planting distances obtained through 3 regenerations is shown in Table 6.

Table 6. Effect of planting distances on dry matter yield (tons/ha/batch)

Regenerations	Planting distances				SEM	p
	10 x 10 cm	20 x 20 cm	30 x 30 cm	40 x 40 cm		
Average	2.83^{A}	3.43^{B}	3.69^{C}	2.70^{A}	0.077	0.000
Batch 1	2.76	2.86^{a}	3.13^{a}	2.43^{a}		
Batch 2	2.78	3.58^{b}	3.79^{b}	2.65^{a}		
Batch 3	2.95	3.84^{b}	4.12^{b}	3.01^{b}		
SEM	0.156	0.144	0.109	0.076		
p	0.629	0.000	0.000	0.000		

SEM: Standard Error of the Mean. A, B, C in the same row and a, b, c in the same column, numbers with different exponent letters are statistically significantly different ($p < 0.05$).

The dry matter yield of *B. humidicola* obtained at two planting distances of 10 x 10 cm and 40 x 40 cm was not statistically different ($p > 0.05$), whereas it was statistically different at the remaining two planting distances ($p < 0.05$). The highest dry matter yield was 3.69 tons/ha/batch at a planting distance of 30 x 30 cm, higher than at the other planting distances ($p < 0.05$). This was consistent with the green matter yield obtained in Table 3.4.

The obtained dry matter yield through batches at the planting distance of 10 x 10 cm was not statistically different ($p > 0.05$). However, at the remaining three planting distances, the yields were different ($p < 0.05$) (Table 5).

According to Nguyen Thi Hong Nhan et al. [4], the dry matter yield of *Paspalum* fluctuated through batches and among planting distances, the dry matter yield at the planting distance of 20 x 50 cm was highest at 4.05 – 6.26 tons/ha/batch.

Protein yield

Protein yield is an important indicator reflecting the quality of animal feed. Crude protein yield is calculated based on dry matter yield and protein ratio. The protein yield of *B. humidicola* in the experiment across planting distances and regenerations is shown in Table 7.

Table 7. Effect of planting distances on protein yield (tons/ha/batch)

Regenerations	Planting distances				SEM	p
	10 x 10 cm	20 x 20 cm	30 x 30 cm	40 x 40 cm		
Average	0.70^{A}	0.90^{B}	0.97^{C}	0.71^{A}	0.019	0.000
Batch 1	0.66^{a}	0.75^{a}	0.83^{a}	0.64^{a}		
Batch 2	0.82^{b}	1.07^{b}	1.13^{b}	0.79^{a}		
Batch 3	0.63^{a}	0.89^{c}	0.96^{c}	0.66^{a}		
SEM	0.025	0.030	0.028	0.020		
p	0.000	0.000	0.000	0.000		

SEM: Standard Error of the Mean. A, B, C in the same row and a, b, c in the same column, numbers with different exponent letters are statistically significantly different (p < 0.05).

Like green matter yield, dry matter yield, the protein yield of *B. humidicola* obtained showed similar results. At the two planting distances of 10 x 10 cm and 40 x 40 cm, there was no statistical difference ($p > 0.05$) while there was a statistical difference compared to the remaining planting distances ($p < 0.05$). The protein yield at a planting distance of 30 x 30 cm was highest at 0.97 tons/ha/batch, higher than the other planting distances ($p < 0.05$). This was consistent with green matter yield and dry matter yield obtained in Tables 6 and 7.

The obtained protein yield through batches at 04 planting distances were statistically different ($p < 0.05$) and varied (Table 3.5). According to the research results of Nguyen Anh Dung [2], the average protein yield on 1-crop soil was 0.68 – 1.46 tons/ha/batch and on 2-crop soil was 0.92 – 2.43 tons/ha/batch. In short, the *B. humidicola* in the experiment had an average protein yield.

According to Nguyen Thi Hong Nhan et al. [4], the protein yield of *Paspalum* fluctuated through batches and planting distances, the

pISSN 1859-1388
eISSN 2615-9678

highest protein yield was 0.32 – 0.62 tons/ha/batch at the planting distance of 20 x 50 cm.

In summary, through the above analysis, among the 04 planting distances, the distance of 30 x 30 cm produced the highest green matter yield, dry matter yield, and protein yield ($p < 0.05$). Under the same conditions in terms of soil, climate, weather, fertilizers, and care, the grass produced different yields under the effect of planting distances. The reason is that each variety is suitable for a certain planting distance, different crops are suitable for different planting distances depending on their biological characteristics. When crops are planted at the right distances, they can easily obtain and use nutrients and energy efficiently to maximize their growth capacity, producing maximum yield. Although the regeneration ability and yield fluctuated through batches, they were still within the normal growth range of the grass varieties.

The purpose of intensive cultivation of *B. humidicola* is to achieve the highest yields per unit area compared to other crops. The *B. humidicola* in the experiment had the highest green matter yield, dry matter yield and protein yield at the planting distance of 30 x 30 cm. This finding is noticeable for intensive cultivation of the grass to increase productivity for the development of cattle farming.

4 Conclusions

Different planting distances affected the growth and yield of *Brachiaria humidicola* grown in Thua Thien Hue province. Among the 4 planting distances, at the 30 x 30 cm planting distance, *Brachiaria humidicola* grew and produced the best yield. Although the growth ability and yield of the grass varieties fluctuated through regenerations, they were still within the normal growth ranges.

Brachiaria humidicola grown at a planting distance of 30 x 30 cm had the optimal plant height of 96.33 cm, grass bed height of 73.38 cm, and number of branches/tussock of 40.17.

The green matter yield, dry matter yield, and protein yield of *Brachiaria humidicola* grown in Thua Thien Hue were relatively high. At the planting distance of 30 x 30 cm, the green matter yield was 13.87 tons/ha/batch, the dry matter yield was 3.69 tons/ha/batch and the protein yield was 0.97 tons/ha/batch.

Reference

1. Department of Agriculture and Rural Development Thua Thien Hue. Developing agriculture in Thua Thien Hue province in a green and sustainable direction in the period 2021 – 2025. Hue: Department of Agriculture and Rural Development Thua Thien Hue; 2024.
2. Dung NA. Yield and nutritional value of Brachiaria Humidicola grass grown in Quang Binh [master's thesis]. Hue: University of Agriculture and Forestry, Hue University; 2017.
3. Giang NT. Assessment of the waterlogging tolerance of some popular grass varieties in Central Vietnam [master's thesis]. Hue: University of Agriculture and Forestry, Hue University; 2016
4. Nhan NTH, Hon NV, Ngu NT, Dien DTT. The effect of planting distance on growth, development and yield of Paspalum Atratum grass in flooded field conditions. Journal of Livestock Science and Technology. 2011;31:81-90.
5. Cu NX, Yen DB. Selection of High-yielding Tree and Grass Species for Cattle Feed Suitable for Ecological Conditions in Ha Giang. Journal Science Journal Science VNU: Earth and Environmental Sciences. 2017;33(1S):1-6.
6. Nhung PTH, Hang DTT, Ngoc TTM, Loc NV, Hanh TT, Long NV. Evaluation of the Growth, Yield and Quality of Some Forage Species at the Different Cutting Times in Gia Lam, Hanoi. Vietnam J Agri Sci. 2020;18(8):580-587.
7. Trong HV, Lan DD, Me VA, Tung LX. Evaluating the growth and green matter yield of chine grass and mulato II grass planed in PU Nhung commune, Tuan Giao district, Dien Bien province.

Journey Science – Tay Bac University. 2021;24:50-55.

8. Hien TQ, Hoan TT, Trung TQ. A study on the green matter and grass meal production performance of Stylosanthes guianensis CIAT 184 cultivated in Thai Nguyen Province. Vietnam Journal Science and Technology. 2017;19(8):23-27.
9. Hue PT. Growth and development of grass VA06 and Ghine TD58 in Eakar district, Dak Lak province. Can Tho University Journal. 2017;51:1-6.
10. Dong LX, Mui NT, Kiem PT. The effect of organic fertilization on the production capacity of some Brachiaria group grass varieties. Ho Chi Minh: Center for Management & Inspection of Plant and Livestock Varieties; 2012.
11. Ba NX, Van NT, Van NH, Ai TN. Ability to produce green matter of some grass varieties in regions of Quang Tri province. Journal of Livestock Science and Technology. 2010;22:52-59.
12. Mui NT, Hanh DD, Loi NV. Experiment to build a model of seed production and green feed on the basis of expanding the area of intensive cultivation of good grass varieties for cow breeding in the Northern Midlands and mountainous areas. Scientific Reports of the Institute of Animal Husbandry; 2006.