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Determination of suitable cutting height for green fodder *Trichanthera gigantea* grown for animal feed

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Abstract

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An experiment in order to determine the suitable cutting height of *Trichanthera gigantea* was carried out at Thai Nguyen University of Agriculture and Forestry, Viet Nam during 2019 – 2020. The experiment consisted of 4 different treatments (NT) respectively to 4 different cutting heights at the first harvesting that were NT1: 30 cm; NT2: 45cm; NT3: 60 cm and NT4: 75 cm measured from ground level. Each treatment was carried out in an area of 23.4 m^2 with 5 replicates; the design was in randomize block. The other factors such as density, fertilizer, and cutting intervals ... were similar among treatments. Results showed that dry matter and crude protein yields were higher in treatments with higher cutting levels; dry matter yield of NT1, NT2, NT3 and NT4 was 7604, 10 972, 12 914 and 12 927 kg/ ha/ year, respectively. That of crude protein was 1959; 2826; 3327 and 3330 kg/ ha/ year respectively. Based on dry matter and crude protein yields and statistical analysis data, it was concluded that for the first harvesting, the cutting height should be 60 cm.

Keywords: cutting height; *Trichanthera gigantean;* animal feed

Introduction

A number of studies reported that cutting height had significant effects on yield of forages (Da Silveira et al., 2010; Padila et al., 2014; Bashar et al., 2017). If the forages are cut too short at the first harvest leaving only stem base without any tillers, nutrients for forage regeneration will be limited since there are no additional nutrients from tillers, which will gradually result in plant decease and death. In contrast, if the cutting is too high, there will be more tillers to regenerate, however, these regenerated tillers are often small with less foliage, which leads to low productivity. The suitable cutting height depends on forage varieties. For example, the cutting height of King Napier grass was 5 – 15 cm (Wijitphan et al., 2009; Lounglawan et al., 2014), of *Moringa oleifera* was 30 – 45 cm (Bashar et al., 2017; Tu Quang Hien et al., 2020). *Trichanthera gigantea* is a woody fodder with multiple harvests, which has been recently focused as animal feed, thus, determination of its suitable cutting height for animal feed production is necessary (Figures 1 & 2).

Fig. 1. Take care of the young *T. gigantea*

Fig. 2. Measure the height of *T. gigantean*

Fig. 3. *Trichanthera gigantea* after the first cut

Materials and Methods

This study focused on *Trichanthera gigantea* for foliage production for animal feeding practice. *Trichanthera gigantea* was planted with stems; each stem was 25 – 30 cm long, containing 3 or 4 leaf nodes.

The experiment was conducted at Thai Nguyen University of Agriculture and Forestry, Thai Nguyen province, located in Northern mountainous area of Vietnam. The experiment lasted in 2 years from 2019 – 2020.

The experiment consisted of 4 formulas (hereinafter refer to as NT) including NT1: 30 cm, NT2: 45 cm, NT3: 60 cm and NT4: 75 cm measured from the ground level to the cutting point. Each formula consisted of 23.4 m^2, 5 replicates, and was assigned in a randomized block design. The other factors such as density, fertilizer application, and harvesting intervals were similar among treatments.

Monitoring parameters included plant mortality, tillers per plant, productivity, biomass yield, fresh foliage, dry matter (DM) and leaf protein content. The productivity and yield were estimated following the method described by Tu Quang Hien et al. (2002).

Mortality was monitored by counting the total number of dead plants of each treatment. The average number of tillers per plant was tracked by counting the tillers of 50 plants (10 plants x 5 plots) of a treatment and then averaging. Productivity was the weight (biomass, fresh foliage, DM) obtained per ha per harvest, expressed as kg/ha/harvest. The average biomass productivity was estimated by harvesting all 5 plots (5 replicates) of each treatment and then averaging. The foliage and biomass ratio was estimated by randomly selecting 10 kg biomass from each plot (5 plots = 50 kg), then separating foliage from branches, tillers, weighed and calculated the average foliage and biomass ratio. Fresh foliage productivity was biomass productivity multiply by fresh foliage and biomass ratio. Dry matter productivity was the fresh foliage productivity multiply by DM percentage in fresh foliage.

Yields (biomass, fresh foliage, DM) were estimated by multiplying the average productivity per harvest in a year with the number of cuttings per year, expressed as kg/ha/year. Crude protein yield was estimated by taking DM yield multiply by crude protein content (%) in DM.

The moisture content in the foliage was done complying with Vietnam standard: 4326 (2001) and for the protein content: 4326 – 1 (2007).

Data was statistically processed following the method described by Do Thi Ngoc Oanh & Hoang Van Phu (2012).

Table 1. *Trichanthera gigantea* mortality after cutting

Categories	Unit	NT1 30 cm	NT1 45 cm	NT3 60 cm	NT4 75 cm	SEM	P
1. Number of plants in a NT	Plant	650	650	650	650		
2. Mortality after 2 first harvests	%	45.5^a	16.3^b	0^c	0^c	2.088	0.000
3. Mortality after year 1	%	50.8^a	20.6^b	2.5^c	1,8^c	1.803	0.000
4. Mortality after year 2	%	53.2^a	22.5^b	3.5^c	3.2^c	2.793	0.000

Note: Numbers with different subscription letters in the same row are significant different ($p < 0.001$)
Table 1 has a dot (.) in the data of SEM

Results and Discussion

Although the majority of data from the experiment was collected, however, within this article only some main results were presented.

The effect of cutting height on Trichanthera gigantea mortality

The plant mortality directly effects on the productivity of forages, thus, this parameter after the 2 first harvests, after the first and 2nd year were recorded and presented in Table 1.

Fifteen days after plantation, the plant stems which did not browse were replaced to make sure that 100% plants browsed. After the 2nd harvest, NT1 had mortality rate of 45.5%, this rate reached 50% after the 1st and 2nd year. This rate was lower in NT2, which was approximately 20% after the 1st and 2nd year. This rate of NT2 and NT3 was less than 4%. The mortality rate of NT1 was higher than that of NT2, NT3, NT4 and that of NT2 was higher than that of NT3, NT4 significantly ($p<0.001$) after the 2nd harvest as well as after the 1st and 2nd year of production. Thus, the shorter cutting height the higher mortality rate and vice versa. This could be explained that the cutting closer to the ground level at the 1st harvest remaining the stem base only without any tillers led to the deficiency of nutrients for regeneration, the only source of nutrients was from the stem base and the roots without the supplement from the foliage. If the forage had not yet accumulated sufficient nutrients in the stem base and roots for plant regeneration, then the plant would die.

For this reason, the determination of optimal cutting height in green fodders is very important. The different fodder varieties required the different suitable cutting height; the suitable cutting height of grass was normally shorter, eg: the cutting height of King Napier grass was 5 – 15 cm (Wijitphan et al., 2009; Lounglawan et al., 2014). The woody stem fodders required higher cutting; for example, cutting height of *Moringa oleifera* (a fodder with soft and spongy stem) was 30 – 45 cm (Padila et al., 2014; Bashar et al., 2017; Tu Quang Hien at al., 2020).

Trichanthera gigantea is a fodder with hard woody stem, thus it requires the higher cutting height; in this experiment, the cutting height of 30 cm had led to the mortality rate of the plants up to 50% after the 1st year.

Effect of cutting height on regeneration, foliage and dry matter contents

The regeneration capacity and the foliage and biomass ratio was significantly affected by cutting height, thus, these parameters were carefully monitored and presented in Table 2.

Data presented in Table 2 showed that the number of regenerated tillers after 1st harvest as well as the average regenerated tillers/ plant/ harvest/ 2 years increased with the cutting height increased. That from NT3, NT4 was higher than from NT1, NT2 and from NT2 was higher than NT1 significantly ($p < 0.001$).

The reason for these differences was that if the cutting height of the 1st harvest was higher, then the remaining stem was longer and the regenerated tillers after the 1st harvest was higher, thus the regeneration of the next harvest tillers was higher. That the regenerated tillers increased when cutting height was higher was also seen in other green fodders such as guinea grass (Onyeonagu & Ugwuanyi, 2012), *Moringa oleifera* (Isah et al., 2014).

At the 1st harvest, the foliage and biomass ratio of NT1 was lower comparing to that of NT2, NT3 and NT4 proximately 2.0 – 4.0%, and that of NT2 comparing to NT3, NT4 was lower proximately 1.4 – 2.0%, however, this difference was significant in NT1 comparing to that of NT4 only ($p < 0.05$). The lower cutting height resulted in higher stem weight that was the reason for the lower foliage and biomass ratio. However, when 2 years' production was taken into account, this ratio was not significantly different among treatments ($p > 0.05$). The reason was that the regeneration tillers from the 2nd harvest were smaller, thus there was no effect on the foliage and biomass ratio in all treatments.

At the first harvest, the DM content in foliage tended to gradually decrease from NT1 to NT4 because NT1 had the

Table 2. Effect of cutting height on regeneration, foliage and dry matter contents

Categories	Unit	NT1 30 cm	NT2 45 cm	NT3 60 cm	NT4 75 cm	SEM	P
2. Tillers/ plant after 1st harvest	Tiller	2.3^c	2.8^b	3.1^a	3.2^a	0.147	0.000
3. AT/plant/ after each harvest	Tiller	3.4^c	3.9^b	4.3^a	4.5^a	0.180	0.000
4. AF/ biomass 1 harvest	%	57.94^b	60.13^{ab}	61.54^{ab}	62.12^a	2.779	0.012
5. AF/biomass of 2 years	%	61.85^a	62.27^a	62.52^a	62.71^a	3.430	0.981
6. FDM content in 1st harvest	%	16.15^a	15.95^a	15.78^a	15.61^a	1.018	0.855
7. AFDM content/ 2 years	%	16.25^a	16.21^a	16.15^a	16.13^a	0.940	0.997

Note: AT is Average Tiller; AF is Average Foliage; FDM is Foliage Dry Matter; AFDM is Average Foliage Dry Matter. Numbers with different subscription letters in the same row are significant different ($p < 0.05 – 0.001$)

Table 3. Effect of cutting height on the productivity of *T. gigantea*

Categories	Unit	NT1 30 cm	NT2 45 cm	NT3 60 cm	NT4 75 cm	SEM	P
1.BP of 1st harvest	kg/ha	38 586^{a}	35 234^{ab}	32 551^{b}	30 124^{b}	4370	0.042
2. ABP./harvest/ 2 years	kg/ha	13 756^{b}	19 764^{a}	23 254^{a}	23 236^{a}	2734	0.000
3. AFP /harvest/2 years	kg/ha	8508^{b}	12 307^{a}	14 538^{a}	14 571^{a}	1707	0.000
4. ADMP/ harvest/ 2 years	kg/ha	1383^{b}	1995^{a}	2348^{a}	2350^{a}	276	0.000

Note: 1) BP is Biomass Productivity, 2) ABP is Average Biomass Productivity, 3) AFP is Average Fresh foliage Productivity, 4) ADMP is Average Dry Matter Productivity. Numbers with different subscription letters in the same row are significant different ($p < 0.05 – 0.001$)

lower cutting height, all old, mature and young foliage were harvested, whereas, that of NT3 and NT4 had the higher cutting height so the majority of harvested foliage were young. However, the ratio of 2 years was not significantly different among treatments ($p>0.05$). This proved that the cutting height did not have effect on the DM content of the foliage. A part from dry matter, the crude protein content was also analyzed; however, our results showed that the cutting height did not have any effect on this parameter. Marguerite Mukangango et al. (2018) who studied on the cutting height of several legumes reported that the cutting height did not have any effect on chemical composition of these fodders.

Effect of cutting height on the productivity of T. gigantea

The cutting height is having significant effect on the productivity of the forages, thus several productivity parameters were recorded and presented in Table 3.

Data presented in Table 3 showed that the biomass productivity of the 1st harvest was significantly affected by the cutting height. If considering the biomass productivity of the 1st harvest of NT1 was 100%, then that of the NT2, NT3 and NT4 were 91.3; 84.4 and 78.1% respectively and the difference of biomass productivity of NT1 comparing to that of NT3, NT4 was significant ($p < 0.05$). The higher biomass productivity in NT1 was because whole stem foliage were harvested. The production of other treatments (especially of NT4) was accounted base on the harvesting from the top. However, after the 2nd harvest, the mortality rate of NT1 was significantly higher than that of NT2, NT3 and NT4 and this rate of NT2 was also higher than that of NT3, NT4. Therefore, the average biomass productivity/ harvest/ 2 years were the lowest in NT1 followed by that of NT2 that of NT3 and NT4 was equivalent. If considering the average biomass productivity/ harvest/ 2 years of NT1 was 100% then that of NT2, NT3 and NT4 was 143.7, 169.0 and 168.8%, respectively; the average biomass productivity/ harvest/ 2 years of NT2, NT3 and NT4 was significantly higher than that of NT1 ($p < 0.001$). The average fresh foliage and DM productivities/ harvest/ 2 years were similar trending compare to that of biomass productivity.

Effect of cutting height on Trichanthera gigantea yield

The monitoring data of average yields (foliage biomass, fresh, DM and CP)/ha/year from different treatments is presented in Table 4.

Data in Table 4 showed that the performance of biomass production was similar to that of biomass productivity; the shorter cutting levels were, the lower yield was obtained and vice versa. Biomass yield of NT1, NT2 was lower than that of NT3, NT4 and that of NT1 was lower than that of NT2 significantly ($p < 0.001$). The biomass yield of NT2, NT3, and NT4 in this experiment was similar to the results from nitrogen application trial (Hien et al., 2019) and the experiment on cutting intervals (Tu Trung Kien et al., 2020) conducted on *T. gigantea.* Therefore, this experiment also ensured the optimal condition for better development of forages.

Fresh foliage, DM, CP yields also had the similar trend to the biomass yield; dry matter and CP yields of NT3, NT4 were higher than that of NT1, NT2 and that of NT2 was sig-

Table 4. Effect of cutting height on *Trichanthera gigantean* yield

Categories	Unit	NT1 30 cm	NT2 45 cm	NT3 60 cm	NT4 75 cm	SEM	P
1.Biomass yield/year	Kg	75 658^{c}	108 702^{b}	127 897^{a}	127 798^{a}	8 683	0.000
2. Foliage yield /ha/ year	Kg	46 794^{c}	67 689^{b}	79 961^{a}	80 142^{a}	5 429	0.000
3. DM / ha/ year	Kg	7 604^{c}	10 972^{b}	12 914^{a}	12 927^{a}	877	0.000
4. CP/ha / year	Kg	1 959^{c}	2 826^{b}	3 327^{a}	3 330^{a}	226	0.000

Note: i) Total harvest/2 years was 11, thus average yield /year = (average productivity/harvest/2 years x 11 harvests): 2, ii) Protein content in foliage DM was 25.76%, this content was applied for all treatments.. Numbers with different subscription letters in the same row are significant different ($p < 0.001$)

nificantly higher than that of NT1 ($p<0.001$). Dry matter and CP yields are the most important parameters to evaluate the experiment results. These parameters of NT3 and NT4 were similar but significantly higher than that of NT1 and NT2. However, the shorter cutting levels would improve production practice; thus, the cutting height of NT3 was the most suitable.

Conclusion

The experiment to determine the suitable cutting height levels for *Trichanthera gigantea* production for animal feed was conducted with 4 cutting height levels (NT) at the 1st harvest, including NT1: 30 cm; NT2: 45 cm; NT3: 60 cm; NT4: 75 cm measured from ground level to the cutting point. Based on the data analysis, it is recommended that the most suitable cutting height level should be 60 cm.

References

Bashar, M. K., Huque, K. S., Sarker, N. R., Sultana, N. & Makkar, H. P. S. (2017). Study of different harvesting height on annual biomass yield, chemical composition and in – Sacco dry matter degradability of Moringa fodder. *International Journal of Agriculture Inovations and Research*, *6 (1),* 50 – 56.

Da Silveira, M. C. T., Junior, D. N., Da Cumha, B. A. L., Pena, G. S. D. K. S., Da Silva, S. C. & Sbrissia, A. F. (2010). Effect of cutting interval and cutting height on morphogenesis and forage accumulation of guinea grass (*Panicum maximum*). *Tropical Grassland*, *44,* 103 – 108.

Hien, T. Q., Quac, N. K. & Nhung, T. T. (2002). Textbook of Grassland and Forage Crops. *Agricultural Publishing House*, Ha Noi, 112 (Viet.).

Hien, T. Q., Kien, T. T., Khoa, M. A., Hoan, T. T. & Trung, T. Q. (2019). Effect of different Nitrogen fertilizer application levels on yield and quality of the green fodder *Trichanthera gigantea*. *Proceedings of X International Symposium on Agriculture and Forestry. Jahorina,* 3 – 6, October, 2019, 1482 – 1487.

Hien, T. Q., Hoan, T. T., Trung, T. Q. & Hiep, P. T. (2020). Determination of suitable cutting height for green fodder *Moringa oleifera* grown for animal feed. *Journal of Animal Husbandry Sciences and Technics, 260,* 67 – 72 (Viet.).

Isah, A. D., Bello, A. G. & Zarumaye, S. A. (2014). Effects of cutting heights and interval of cutting on the yield of *Moringa oleifera* (horse raddish). *International Journal of Development and Sustainability, 3 (5)*, 1147 – 1151.

Kien, T. T., Khoa, M. A., Hoan, T. T. & Hien, T. Q. (2020). Effect of cutting intervals on yield and quality of the green fodder *Trichanthera gigantea*. *AGROFOR International Journal, 5 (1),* 22 – 29.

Lounglawan, P., Lounglawan, W. & Suksombat, W. (2014). Efect of cutting interval and cutting height on yield and chemical composition of King Napier grass (*Pennisetum purpureum x Pennisetum americanum*). APCBEE Procedia, 27 – 31.

Mukangango, M., Wredle, E., Mutimura, M. & Sigrun Dahlin, A. (2018). Effect of cutting height on nutrition characteristics of three agroforestry tree legume species and their feed supplement value on *Chloris gayana* Kunth. *Journal of Agricultural Research, 13 (31),* 1591- 1597.

Oanh, D. T. N. & Phu, H. V. (2012). Textbook of Field Experimental Methods. *Agricultural Publishing House,* Ha Noi, 210 (Viet.).

Onyeonagu, C. C. & Ugwuanyi, B. N. (2012). Influence of cutting height and nitrogen fertilization on plant height and tiller production of guinea grass (*Panicum maximum* Jacq) pasture. *African J. of Agri. Research, l 7 (48),* 6401 – 6407.

Padila, C., Nidia F., Idania, S., Tuero, R. & Lucia, S. (2014). Effect of cut height on indicator of forage production of *Moringa oleifera* CV. Plain. *Cuban Journal of Agricultural Science*, *48 (4),* 405 – 409.

Vietnam Standard: 4326: 2001 (ISO 6496: 1999). Animal Feed, Moisture Determination Method, 23 – 26 (Viet.).

Vietnam Standard: 4328 – 1: 2007 (ISO 5983 – 1: 2005). Animal Feed, Method for Determination of Nitrogen and Protein, 32 – 35 (Viet.).

Wijitphan, S., Lorwilai, P. & Arkaseang, C. (2009). Effect of cutting heights on productivity and quality of King Napier grass (*Pennisetum purpureum* CV. King Grass) under irrigation. *Pakistan Journal of Nutrition, 8(8),* 1244 – 1250.

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