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Change in dry matter and nutritive composition of *Brachiaria humidicola* grown in Ban Thon soil series

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Abstract: This experiment was conducted to determine the change in dry matter and nutritive composition of Humidicola grass (*Brachiaria humidicola*) grown in Ban Thon soil series (infertility soil) as a function of growth age. One rai (0.16 ha) of two-year-old pasture of fertilised Humidicola grass was uniformly cut and the regrowth samples were collected every twenty days. The samples were subjected to analysis for dry matter content and nutritive composition, i.e. crude protein, ash, calcium, phosphorus, neutral detergent fibre, acid detergent fibre, and acid detergent lignin. The results showed that while the yields of available forage and leaves increased curvilinearly (quadratic, $p<0.05$), the stem yield increased linearly ($p<0.05$) over sampling dates. The highest biomass accumulation rate was numerically observed between 40-60 days of regrowth. The concentrations of crude protein, ash, calcium and phosphorus decreased curvilinearly (quadratic, $p<0.05$) with advancing maturity and reached the lowest flat after 60 days of regrowth. The cell wall components, i.e. NDF, ADF and ADL, increased over the experimental period and reached the highest plateau at 40 days of regrowth. It was concluded that Humidicola grass should be grazed or preserved at the regrowth age of not over 60 days to maximise the utilisation of the grass.

Keywords: *Brachiaria humidicola*, Ban Thon soil series, animal nutrition

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Introduction

Humidicola grass (*Brachiaria humidicola*) is a procumbent stoloniferous perennial with lenceolate leaves. The culm is prostrate in the lower part where it roots from the lower nodes. It is distinguished from other species of the genus by its creeping habit. Although containing low crude protein (CP) (3.75-6.25% CP, DM basis), it has good drought tolerance and remains green better than other species [1,2]. It is the common green forage using as the main roughage source for beef cattle and goat production in Narathiwat province, especially in Ban Thon soil series area that covers an area of at least 54,544 rais (8,727 ha).

Ban Thon soil series is very poor physically, chemically and biologically, containing approximately 0.29% organic matter, 1.0 g kg^{-1} available phosphorus, and 14.5 g kg^{-1} exchangeable potassium [3]. Sukkasem et al. [2] reported that when four tons of cattle manure were applied to Humidicola grass and the grass was cut every 50 days, it yielded approximately 2 tons of dry matter per year with a content of 6.82% CP, 32.21% acid detergent fibre (ADF), and 66.68% neutral detergent fibre (NDF). Prajakboonjetsada et al. [4] also reported that Humidicola grass hay (harvested at day 70 of regrowth age) contained 4.4% CP, 67.82% NDF and 38.07% ADF. When this grass was fed to beef cattle supplemented with 1% body weight of feed concentrate, it resulted in 4.38 kg/d of dry matter forage intake and 0.542 kg/d of average daily gain of cattle [4].

Forage quality evaluation during the growth cycle would allow us to pinpoint when to harvest the grass at the desired levels of nutritive composition to meet specific animal requirements [5], especially CP concentration [6]. Maintaining appropriate stage of pasture could be a good option in pasture management for improving animal productivity. Although there have been general reports regarding the effect of fertiliser on the quantity and quality of Humidicola grass, there seems to be no scientific evidence on its profile of DM yield and nutritive composition in accordance to its stage of growth. The objective of this study is thus to try to gather this potentially useful information.

Materials and Methods

Soil characteristics and pasture management

The experiment was carried out, starting from 26 September 2006, at Narathiwat Animal Nutrition Research and Development Centre, Takbai, Narathiwat, Thailand. The soil involved in this study was classified as Ban Thon soil series. It was sandy, siliceous, superactive, ortstein, isohyperthermic, Typic Haplorthods [3]. The chemical properties of the soil have been previously reported by Sukkasem et al. [7]. It was considerably acid ($pH_{water\ 1:1}$ = 5.60), low in organic matter content (2.9 g kg^{-1}) with available phosphorus, exchangeable potassium and total sulphur concentration of 1.0, 14.5 and 12.5 g kg^{-1} respectively.

One rai (0.16 ha) of 2-year-old Humidicola grass was cut using a drum mower instrument for a uniform regrowth. The experimental field was equally divided into 4 plots (approximately 0.25 rai or

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0.04 ha per plot) and each plot was separated by a 1.5-m spacing, and fertilised once at the beginning of the experiment with N-P-K fertiliser (15-15-15) and nitrogen fertiliser (46-0-0, urea) at 25 kg/rai and 10 kg/rai respectively. No irrigation was practiced over the experimental period. The precipitation accumulation level throughout the experiment was 462.12 mm.

Sample collection and preparation

Starting from 5 October 2006 as day 1, the green yield of Humidicola grass was sampled on day 20, 40, 60, 80, and 100 with 4 replications each. The grass was sampled by clipping five 0.16-m^2 quadrates per plot at approximately 3-cm stubble height. No area within the plot was clipped more than once so that all clipped forage was an original regrowth (plant plus new tillers). All clipped forage samples were weighed and dried individually in a hot-air oven at approximately 60 °C for 48 hr. The dry weight for each quadrate sample was used to estimate available forage yield. All of weeds and death materials were separated by hand and removed before forage calculation. Dry leaves and stems were separately weighed and ground through a 1-mm screen in a Wiley mill for chemical analysis.

Chemical analysis

All ground samples were subjected to proximate analysis of dry matter (DM), ash, and crude protein (CP) by the methods of AOAC [8]. The detergent fibre composition, i. e. neutral detergent fibre (NDF), acid detergent fibre (ADF), and acid detergent lignin (ADL), was analysed by the procedures described by Goering and Van Soest [9]. The CP was calculated as percentage of nitrogen in the sample multiplied by a factor of 6.25. Calcium and phosphorus were determined by the methods of AOAC [10].

Statistical analysis

Effects of regrowth age on dry matter yield (available forage yield and leaf blade and stem yield) and nutritive composition of grass were analysed as a randomised complete block design with field blocks (n = 4) as replications and the 5 regrowth ages (day 20, 40, 60, 80 and 100) as treatment. This statistical method was described by Ogden et al. [11] and Ogden et al. [12]. Growth age means were separated by single-degree-of-freedom orthogonal contrasts for linear, quadratic and cubic effects of time using SAS statistical package [13].

Results and Discussion

Agronomic traits

Least square means of available forage yield, and leaf and stem yields of Humidicola grass at twenty-day interval sampling from day 20 through day 100 of regrowth are shown in Table 1. The statistical analysis results reveal that the DM yield of available forage (quadratic, p=0.0391), leaf yield

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(quadratic, p=0.0044) and stem yield (linear, p<0.0001) increased with sampling dates. The growth rate of the grass reached the peak after day 80 of regrowth.

The curvilinear response of DM yield of available forage and leaf yield might occur because of the emergence of new tillers throughout the sampling period when there was rain. This result was consistent with the reports of Isuwan et al. [14] and Ogden et al. [11], who showed that dry matter yield and leaf percentage of Pangola grass (*Digitaria eriantha*) and crabgrass (*Digitaria ciliaris*) reflect significantly the curvilinear effect of the plant regrowth age caused by the release of new immature tillers late in the sampling period. Differing from both traits above, the stem yield linearly increased over the sampling period. This might be due to the emergence of new immature tillers when the grass approached maturity and possessed leaves with less stems.

Table 1. Least square means of available forage, leaf and stem yields of Humidicola grass (kgDM/rai) harvested at different regrowth ages

Regrowth age (days)	Available forage yield[1]	Leaf yield	Stem yield
20	12.72	9.45	3.01
40	42.83	26.90	15.08
60	142.84	81.43	58.86
80	190.73	107.34	78.15
100	356.31	234.91	116.75
SEM[2]	25.26	14.64	9.99
Contrast	*P-value*		
Linear	<0.0001	<0.0001	<0.0001
Quadratic	0.0391	0.0044	0.4592
Cubic	0.5607	0.1884	0.7014

[1] Almost all of weeds and death materials were removed before available forage calculation.
[2] Standard error of the mean (n = 4)

The dry matter yield of grass in this study was obviously lower than those which were reported by Sukkasem et al. (361.45 kgDM/rai/cut at 50 days of growth age) [2] and Thinnakorn et al. (478.3, 844.5 and 1,122.9 kgDM/rai/cut, at 4, 6 and 8 weeks of growth age respectively) [15]. The difference in DM yields may be due to the difference in soil fertility (organic matter content) [15] and organic fertilisation application [2]. Another report [16] concluded that the DM production of this grass is strongly influenced by soil fertility and the productivity ranges from 1.12-5.44 tons/rai/year.

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Nutritive composition

The nutritive composition of Humidicola grass at each stage of regrowth is presented in Table 2. While the DM content linearly increased (linear, $p = 0.0135$), the concentration of CP decreased (quadratic, $p<0.0001$) when the grass was reaching maturation and both items reached their plateau or flat after day 60 of regrowth. Unlike the trend of CP concentration, the concentrations of NDF, ADF and ADL increased (quadratic, $p<0.0001$, $p=0.0009$ and $p = 0.0032$ respectively) over the experimental period and reached the plateau at about day 40-60. The Ca and P concentration decreased in a curvilinear fashion (quadratic $p < 0.0001$ and $p = 0.0103$ respectively) and remained constant after day 60 through the end of the experiment.

Though the results of this study are not different from those of Sukkasem et al. [2], which reported that when four tons of cattle manure were applied, crude protein and cell wall components (NDF and ADF) were 6.82, 66.68 and 33.21% respectively, these are obviously different from the report of Tinnakorn et al. [15], which indicated that grass planting in high fertility soil (Pak Chong soil series) contained 13.87, 12.75 and 8.10% CP, and 62.05, 60.85 and 69.62% NDF, and 38.07, 35.06 and 42.94 % ADF at day 30, 45 and 60 of regrowth respectively. Minson and Wilson [17] suggested that grass should contain at least 6% CP to sustain the activity of microorganisms in the reticulo-rumen of the animal. This study shows that the grass over 60 days of regrowth does not contain the optimum crude protein concentration.

Table 2. Least square means of nutritive composition of Humidicola grass harvested at different regrowth ages

Regrowth age (days)	DM (%)	CP	Ash	Ca	P	NDF	ADF	ADL
		(%DM)						
20	18.88	13.53	8.34	0.27	0.60	62.96	33.08	3.17
40	18.30	8.52	7.03	0.20	0.49	72.65	37.54	5.35
60	21.91	6.83	5.77	0.06	0.38	78.84	41.19	5.99
80	21.75	5.68	5.34	0.07	0.36	78.81	42.36	5.46
100	23.22	5.17	5.15	0.09	0.34	79.58	43.32	5.26
SEM[1]	0.91	0.44	0.29	0.015	0.024	1.07	0.58	0.44
Contrast					*P-value*			
Linear	0.0135	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0083
Quadratic	0.9251	<0.0001	0.0159	<0.0001	0.0103	<0.0001	0.0009	0.0032
Cubic	0.4233	0.0786	0.8468	0.0832	0.9480	0.2297	0.7487	0.2438

[1] Standard error of the mean (n = 4)

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Generally, as a plant is maturing, the CP decreases while the cell wall components increase and digestibility and energy content decline. These responses are relatively well known and the obvious means to minimise the effects of maturity is to harvest at optimum maturity [18,19]. The decline in protein concentration with advancing maturity occurs because of the decrease in protein both in the leaves and stems. It is also because the stems, with their lower protein concentration, make up a larger portion of the herbage in more mature forage [20]. Van Soest [21] also reported that the decline in forage quality is associated with the stage of maturity of the grass. Forage intake by the animals may be less than optimum for appropriate growth when they feed on low quality forage which contains fibrous bulk. Moreover, the higher the concentration of cell walls in the forage, the lower it is consumed by the animal, resulting in reduction in growth.

Conclusions

Maturity stage or regrowth age is an important factor affecting DM yield and nutritive composition of Humidicola grass. Harvesting the grass at an appropriate stage of maturity will bring about an increase in both quantity and quality of the forage. The quality of Humidicola grass considerably decline with advancing maturity. The regrowth age of the grass at not over 60 days seems to be appropriate for animal grazing and for maximising the utilisation of Humidicola grass grown in Ban Thon soil series.

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