In the remaining plots, *Eremochloa ciliaris* grew vigorously.

## Discussion

This study found that none of the legumes tested was able to persist either in pure swards or when growing with N-fertilised grass under cutting on low lying sites in north-east Thailand, confirming the results found earlier by Hare *et al.* (1999a). Establishment of legumes has never been a problem on such sites, with many legumes in pure swards producing over 4 t/ha DM in the first growing season and even reaching 14 t/ha DM, as was the case with Lee American jointvetch at one site (Table 11). The difficulty of legume persistence thereafter appears to be a combination of wet and dry conditions, competition from N fertilised grasses and cutting management.

We may have more success with legumes if we cut less frequently at a greater height, 20–30 cm above ground level, rather than cutting every 45–55 days to 5 cm above ground level. However, this would necessitate a change of management by village farmers who raise livestock.

Our philosophy in introducing legumes and grasses to village farmers is that the selected plants must be adapted to the current low cutting or continuous grazing management currently practised by livestock farmers. This is why Verano stylo has been so successful in upland, well drained soils in north-east Thailand. It tolerates heavy grazing and being a prolific seeder, even under these conditions, re-establishes itself each year (Hare and Phaikaew 1999). If we were to recommend less frequent and high cutting to livestock farmers, this would introduce an additional management factor for farmers to consider. Just getting farmers to establish improved species and apply fertiliser is an achievement in itself. Getting them to adopt a different cutting management for legumes will take time.

In these studies, nitrogen was applied frequently in order to study the potential of the grasses to produce on these very difficult infertile soils. Previous studies had found that, with either no nitrogen or less frequent applications, grasses quickly became very yellow and nitrogen-deficient (Hare *et al.* 1999c). Applications of more than 100 kg/ha N are far in excess of what smallholder farmers would apply to their pastures. Normal rates in villages would be either no fertiliser or 1 application of 20 kg/ha N in the wet season. Thus, pastures commonly die out within 2 years from a combination of lack of fertiliser and close and frequent grazing or cutting.

At the beginning of the study, we considered that *S. guianensis* CIAT 184 (Tha Phra stylo) would be successful. To a limited extent it was as, in pure swards, it persisted into the second wet season but only in a few plots into the second dry season. The cutting management we used may be a factor in its lack of persistence. *S. guianensis* CIAT 184 grew well in the American tropical rainforest ecosystem after one cut at 12 weeks of age (Amezquita *et al.* 1991). In China, it is usually cut only once a year when grown for feed meal production or as a cover crop (Guodao and Kerridge 1997). Where more frequent cutting has been practised in China, the sites have been on well drained, high pH (6.4), reddish brown, lateritic soils (Guodao and Kerridge 1997) and not on poorly drained, infertile, low pH, sandy soils like those used in the current study in Thailand. However, on well drained, upland soils in north-east Thailand, CIAT 184 grows very well, and in current trials at UBU, CIAT 184 and the hybrid stylo (ATF 3308 *S. guianensis* var. *vulgaris* × var. *pauciflora)*, produced 9030 and 8470 kg/ha DM, respectively, in the first wet season and 4024 and 2639 kg/ha DM in the first dry season. The cutting was infrequent with only 2 wet season cuts and 1 dry season cut. In our own pasture programme at UBU, pure stands of Tha Phra stylo and the hybrid stylo (ATF 3308) are grazed to about 30 cm height and closed to grazing during the main flowering and seed-set period from December–February.

We expected to have more success with Lee American jointvetch given that an annual ecotype of *Aeschynome americana* grows naturally in wet areas along roadsides and around swampy ungrazed wasteland in north-east Thailand. This native legume is rarely cut for forage and is allowed to grow rank and set seed every year. Cutting once a year at the end of the dry season enabled Glenn American jointvetch to grow well for 3 years on seasonally flooded clay and solodic soils in the Northern Territory, Australia (Ross and Cameron 1991). It was able to re-establish each year from fallen seed. This current study showed that Lee has the potential to grow well here, as it produced 14 t/ha DM at one site in the first growing season. Studies of persistence mechanisms could result in management strategies that would improve persistence of Lee under cutting.

However, cropping farmers do have more success with legumes if they regard them as annual cash crops to sell to livestock farmers as fresh grass or hay and cut only once or twice a year. On well drained upland soils, several legumes are being promoted as cash crops by the Department of Livestock Development in Thailand for specialist fresh forage and hay production (Khemsawat and Phonbumrung 2002). The main legume is Cavalcade and more than 3000 farmers will grow up to 0.32 ha for sale to other farmers. They will not use the forage for themselves. The other legumes are Verano stylo and Tha Phra stylo. Under once or twice-a-year cutting all of these legumes grow very well but they have to be replanted each year as the last cut is before seed set.

This study found that, on sites deeply waterlogged in the wet season (DET and SAC), only 3 grass species (Ubon paspalum, plicatulum and Splenda setaria) were able to persist, confirming the earlier results of Hare *et al.* (1999a).

On sites that were wet but not severely waterlogged, Purple guinea grass was either equal in production to or more productive than these 3 species. Purple guinea is a good quality pasture grass and, on sites such as MUK, has the potential to produce in excess of 33 t/ha DM in a 6-month wet season. Even in the second and third dry seasons on these low lying sites, no species produced more dry matter during the dry season than Purple guinea grass. We therefore recommend Purple guinea grass as a "cut-and-carry" forage for non-waterlogged sites in Thailand. It is currently one of the best grass species recommended for planting in backyard forage plots and for hay and silage production by the Department of Livestock Development in Thailand (Khemsawat and Phonbumrung 2002).

Ruzi, signal grass and Jarra digit performed best on sites that did not become inundated with water in the wet season. However, even on these sites, they were not as productive as Ubon paspalum, plicatulum and Purple guinea grass. On the inundated sites, they either produced low yields or died out.

Rainfall during the studies (1997–1999) was sites. Unfortunately, the trial areas had either been grazed or cultivated so no data could be collected from the grass species growing under wetter-than-normal field conditions. Observations from our university pastures showed that, under these very wet-waterlogged conditions, Ubon paspalum, plicatulum and Splenda setaria performed the best. Signal grass, ruzi, Jarra digit and Purple guinea struggled to survive in places that were inundated with water for periods longer than 1 month.

## Acknowledgements

We thank the Thailand Research Fund (TRF) for providing financial support for this research program; the Faculty of Agriculture, Ubon Ratchathani University for research facilities; and the Department of Livestock Development and the Agricultural Colleges for research sites and assistance on their field stations. We also thank Mr Kittipat Saipraset for technical assistance.

## References

AMEZQUITA, M.C., TOLEDO, J.M. and KELLER-GREEN, G. (1991) Agronomic performance of *Stylosanthes guianensis* cv. Pucallpa in the American tropical rain forest ecosystem. *Tropical Grasslands*, **25**, 262–267.

GUODAO, L. and KERRIDGE, P.C. (1997) Selection and utilization of *Stylosanthes guianensis* for green cover and field meal production in China. *Proceedings of the XVIII International Grassland Congress, Canada, 1997*. Session 19, 49–50.

HARE, M.D. and PHAIKAEW, C. (1999) Forage seed production in Northeast Thailand: A case history. In: Loch, D.S. and Ferguson, J.E. (eds) *Forage Seed Production Volume 2. Tropical and Subtropical Species*. pp. 435–443. (CAB International: UK).

HARE, M.D., THUMMASAENG, K., SURIYAJANTRATONG, W., WONGPICHET, K., SAENGKHUM, M., TATSAPONG, P., KAEWKUNYA, C. and BOONCHARERN, P. (1999a) Pasture grass and legume evaluation on seasonally waterlogged and seasonally dry soils in north-east Thailand. *Tropical Grasslands*, **33**, 65–74.

HARE, M.D., BOONCHARERN, P., TATSAPONG, P., WONGPICHET, K., KAEWKUNYA, C. and THUMMASAENG, K. (1999b) Performance of para grass (*Brachiaria mutica*) and Ubon paspalum (*Paspalum atratum*) on seasonally wet soils in Thailand. *Tropical Grasslands*, **33**, 75–81.

HARE, M.D., SURIYAJANTRATONG, W., TATSAPONG, P., KAEWKUNYA, C., WONGPICHET, K. and THUMMASAENG, K. (1999c) Effect of nitrogen on production of *Paspalum atratum* on seasonally wet soils in north-east Thailand. *Tropical Grasslands*, **33**, 207–213.

IBRAHIM, L., LANTING, E., KHEMSAWAT, C., WONG, C.C., GUODAO, L., PHIMPHACHANHVONGSOD, V., BINH, L.H. and HORNE, P.M. (1997) Forage grasses and legumes with broad



KEMSAWAT, C. and PHONBUMRUNG, T. (2002) Thai Government promotes fodder production and encourages marketing. (Southeast Asia Feed Research and Development Network) *Seafrad News*, **12**, 9.

ROSS, B.J. and CAMERON, A.G. (1991) Pasture legume evaluation on seasonally flooded soils in the Northern Territory. *Tropical Grasslands*, **25**, 32–36.

*(Received for publication January 4, 2002; accepted October 31, 2002)*

# Appendix 2

*Tropical Grasslands* (2001) Volume 35, 144–150



## Effect of cutting on yield and quality of *Paspalum atratum* in Thailand

M.D. HARE[1], M. SAENGKHAM[1], C. KAEWKUNYA[1], S. TUDSRI[2], W. SURIYAJANTRATONG[1], K. THUMMASAENG[1] AND K. WONGPICHET[1]

[1] *Faculty of Agriculture, Ubon Ratchathani University, Ubon Ratchathani, Thailand*

[2] *Faculty of Agriculture, Kasetsart University, Bangkhen, Bangkok, Thailand*

### Abstract

Two trials were conducted to determine the effect of varying cutting height and interval on growth and forage quality of Ubon paspalum (*Paspalum atratum*) pastures grown in Thailand on low fertility soils. In Trial 1, an increase in cutting height (from 0 to 20 cm above ground level) increased total DM yield at 20-d cutting intervals, had no effect at 30 days and decreased yields at 60-d cutting intervals. Cutting interval significantly increased DM yields in Trial 1 with the major response between 30- and 60-d intervals. Increasing the interval between harvests reduced concentrations of CP, K and P but increased the concentrations of NDF and ADF. In Trial 1, increases in cutting interval and cutting height increased stubble and root DM per plant.

In Trial 2, Ubon paspalum DM yields generally were significantly different only between 20- and 60-d cutting intervals. Cutting every 20 days over a 240-d period produced 74% (21.6 t/ha) of the total DM yield from cutting every 60 days (28.9 t/ha) but crude protein concentration was nearly twice as high (10.0 *vs* 5.3%).

The cutting interval to be chosen by farmers is discussed in terms of the combination of yield and quality desired to produce different animal products.

Correspondence: M.D. Hare, Faculty of Agriculture, Ubon Ratchathani University, Warin Chamrab, Ubon Ratchathani 34190, Thailand. Email: Michael@agri.ubu.ac.th

### Introduction

*Paspalum atratum* cv. Ubon grows well on wet, waterlogged acid soils in Thailand (Hare *et al.* 1999a; 1999b), and can be either grazed or utilised as cut-and-carry forage by farmers. The majority of smallholder dairy farmers in Thailand prefer the cut-and-carry forage system with improved forages, where cows are yarded and fed freshly cut forage and concentrate supplements. Land is a limiting factor with an average stocking rate of less than 0.2 ha per cow and the cut-and-carry system fits in well with normal management.

Ubon paspalum has low crude protein concentration (Hare *et al.* 1999a), frequently falling below 7%. This crude protein level is considered a critical point (Milford and Minson 1966) where nitrogen needed by rumen microorganisms becomes limiting unless some other nitrogen source is provided (Kalmbacher *et al.* 1997a). The level and frequency of nitrogen application and the frequency and height of cutting influence the quantity and quality of tropical forage grasses.

In Thailand on low fertility soils, nitrogen rates of 80 kg/ha N every 30 days were required to maintain crude protein levels of Ubon paspalum above 7% but only when fields were not waterlogged (Hare *et al.* 1999d). In these trials, the cutting frequency was critical, with a 60-day cutting frequency producing significantly ($P < 0.05$) more dry matter than a 30-day cutting frequency, but crude protein concentrations in the older forage were lower (8 *vs* 10%).

In Florida, Kalmbacher *et al.* (1997a) showed that crude protein concentrations in *P. atratum* cv. Suerte dropped below 7% by 55 days after receiving 56 kg/ha N. However, if cut every 35 days, Suerte maintained crude protein concentrations above 7% but more than a single application of 56 kg/ha N was needed in the summer (Kalmbacher and Martin 1999). Cutting Suerte every 20 days reduced annual yield compared with a 40- or 60-d interval but maximised nutritive value (Kalmbacher *et al.* 1997b). Kalmbacher *et al.* (1997b) concluded that, at times of rapid growth, Suerte should be grazed at 21–28-d intervals but at 36–42-d intervals when it is growing less rapidly.

In the initial evaluation trials of Ubon paspalum in Thailand with 45–50-d cutting intervals in the wet season, dry matter production regularly exceeded 20 t/ha in 6 months but crude protein levels averaged only 5%, despite being fertilised with 40 kg/ha N after each cut (Hare *et al.* 1999a; 1999b). Forage quality could be improved if more frequent and intense cutting was practised (Kalmbacher *et al.* 1997b; Kalmbacher and Martin 1999; Hare *et al.* 1999d), but the beneficial effects of improved forage quality may be outweighed if forage growth rates were severely reduced.

The aim of this study was to determine the effect of varying cutting interval and cutting height on growth and forage quality of Ubon paspalum pastures in Thailand on low fertility soils in order to provide recommendations on cutting management to smallholder farmers.

## Materials and methods

The field experiments were conducted in Ubon Ratchathani province, Thailand (15°N, 104°E), on the Ubon Ratchathani University farm at 1 site in a 0.25 ha field in 1998 and 1999. Rainfall was recorded 1 km from the trial site (Table 1). The soil is classified as a sandy low humic gley soil (Roi-et soil series) mixed with a grey podzolic soil (Khorat soil series). The soil is acid (pH 4.7), and low in organic matter (0.74%), N (0.03%), P (3.57 ppm; Bray II extraction method) and K (25 ppm) concentrations.

Seedlings of Ubon paspalum were planted in 50 × 50 cm grid spacings in the field in May 1995. The field was used for seed production research in 1996 and 1997 (Hare *et al.* 1999c). These trials examined harvesting methods and time of final closing cut and did not influence plant populations in the field. After the 1997 seed trial, the field was cut to ground level, was not fertilised and was left to grow over the dry season until the first cutting trial commenced in May 1998.

### *Trial 1. Effect of cutting interval and cutting height*

The trial was a randomised complete block design replicated 4 times and the treatments were 3 cutting heights (0, 10 and 20 cm above ground level) and 3 cutting intervals (20, 30 and 60 days). The trial ran for 120 days, commencing on May 9, 1998 and finishing on September 6, 1998. On May 9, all plots were cut to ground level and fertiliser (40 kg N, 20 kg P, 50 kg K and 20 kg S/ha) applied. The same fertiliser rates were applied every 30 days. Plots measured 5 m × 4 m.

Before each cut, 4 plants per plot were measured for plant height (ground level to top of tallest extended leaf), number of tillers per plant and number of leaves per plant. At each cut, material from 2 m row lengths from each of 4 rows was cut, weighed fresh and a 200 g subsample separated into leaf and stem components. Each component was dried at 70°C for 48 h and dry weight recorded. The dried leaf and stem subsamples were analysed for total N to calculate crude protein levels (% N × 6.25), % P, % K, % NDF and % ADF. After each sampling cut, the remaining forage was cut and removed. After the final cut at 120 days, 2 cut plants per plot from 2 replications were dug out and separated into stubble (remaining leaf and stem) and root components for dry weight analysis.

On September 10, 1998, the field was cut to ground level, material removed and plants allowed to grow over the dry season until Trial 2 commenced on April 16, 1999. No fertiliser was applied after the final cut or during the dry season.

### *Trial 2. Effect of cutting interval*

This trial was in the same field as Trial 1 but plots were not exactly on the same site. Before marking out the trial, the field was carefully examined to get an even plant population to position the trial. The trial was a randomised complete block design comprising 4 cutting intervals (20, 30, 40 and 60 days) and 6 replications. The trial commenced on April 16, 1999 and finished on December 13, 1999. On April 16 all plots were cut to 5 cm above ground level and 156 kg/ha NPK fertiliser (15:15:15) applied. Each plot measured 5 m × 4 m. The trial was divided into two 120-day periods.

Before each cut, height of 10 plants per plot was measured (as in Trial 1). At each cut, four

0.25m² quadrats were cut to 5 cm above ground level from each plot, divided into stem and leaf, weighed fresh and a 200 g subsample of each component dried at 70°C for 48 h and dry weight recorded. The dried stem and leaf subsamples were analysed for total N in order to calculate crude protein levels. After each sampling cut, the remaining forage was cut and removed. Fertiliser at 156 kg/ha NPK (15:15:15) was applied to all plots every 30 days.

Data from both trials were analysed using the IRRISTAT programme from IRRI.

## Results

### *Rainfall*

Rainfall during the studies was about 10% below the medium-term mean of 1503 mm/annum (Table 1). In both years, rainfall was evenly distributed in the wet season except for a dry period in August 1999 when less than half the medium-term mean rainfall was received. No waterlogging occurred at the trial sites during the studies.

**Table 1.** Rainfall at Ubon Ratchathani University during the study and the medium-term mean.

| Month | Rainfall (mm) | | |
|---|---|---|---|
| | Mean[1] | 1998 | 1999 |
| Jan | 1 | 0 | 1 |
| Feb | 11 | 44 | 3 |
| Mar | [illegible] | 0 | 92 |
| Apr | 80 | 60 | 92 |
| May | 223 | 294 | 235 |
| Jun | 258 | 183 | 221 |
| Jul | 240 | 168 | 291 |
| Aug | 228 | 193 | 96 |
| Sep | 296 | 208 | 256 |
| Oct | 98 | 85 | 95 |
| Nov | 34 | 106 | 0 |
| Dec | 5 | 0 | 0 |
| Total | 1503 | 1341 | 1382 |

[1]7-year mean, 1993–1999.

### *Trial 1. Effect of cutting interval and cutting height*

In Trial 1, treatment effects were generally significant. There was a significant ($P < 0.05$) cutting height × cutting interval interaction for total DM and leaf DM yields (Table 2). An increase in cutting height increased yields at 20-d cutting intervals, had no effect at 30 days and decreased yields at 60-d cutting intervals. Increasing the interval between cuttings from 20 to 60 days increased total DM yields regardless of cutting height but increased leaf DM yield only when cut at ground level. Peak DM yields were 14t/ha produced from two 60-d cutting intervals.

**Table 2.** Effect of cutting height and cutting interval on total DM and leaf DM yield of Ubon paspalum in 1998 (Trial 1).

| Cutting interval (d) | Cutting height (cm) | | |
|---|---|---|---|
| | 0 | 10 | 20 |
| | | Total DM (kg/ha) | |
| 20 | 5 686 | 7 218 | 8 232 |
| 30 | 8 346 | 7 107 | 8 054 |
| 60 | 14 392 | 13 620 | 11 634 |
| | | LSD ($P < 0.05$) 2485 | |
| | | Leaf DM (kg/ha) | |
| 20 | 4 419 | 6 412 | 7 512 |
| 30 | 6 021 | 5 683 | 6 456 |
| 60 | 8 833 | 8 160 | 6 870 |
| | | LSD ($P < 0.05$) 2050 | |

The only other significant effect of cutting height was an increase in plant height at harvest as cutting height increased ($P < 0.01$: Table 3). All other interactions were non-significant, so main effects only are presented (Table 3).

As the interval between harvests increased, plant height, stem DM and leaves/plant increased ($P < 0.01$), with the major response between 30- and 60-d intervals (Table 3). Tillers/plant were not affected by cutting interval.

**Table 3.** Effect of cutting height and cutting interval on height, stem DM, tillers/plant and leaves/plant of Ubon paspalum in 1998 (Trial 1).

| Cutting interval(d) | Height (cm) | Stem DM (kg/ha) | Tillers/ plant | Leaves/ plant |
|---|---|---|---|---|
| 20 | 66.5 c[1] | 932 b | 61 a | 188 b |
| 30 | 78.9 b | 1782 b | 51 a | 208 b |
| 60 | 130.7 a | 5261 a | 62 a | 298 a |
| Cutting height (cm) | | | | |
| 0 | 79 c | 3050 a | 56 a | 234 a |
| 10 | 91 b | 2563 a | 61 a | 241 a |
| 20 | 105 a | 2361 a | 57 a | 219 a |

[1]Within columns and treatment factors, means followed by a common letter are not significantly different at P = 0.05 by Duncan's Multiple Range Test

There were no significant cutting height × cutting interval interactions for quality attributes and main effects only are presented (Table 4). Increasing the interval between harvests reduced concentrations of CP, K and P but increased the concentrations of NDF and ADF ($P < 0.05$; Table 4). Mean crude protein concentration declined from 6.8% when harvested every 20 days to 4.1% when harvested every 60 days.

Increasing cutting height reduced P concentration and increased NDF and ADF concentrations, while effects on CP% and K% were minimal (Table 4).

**Table 4.** Effect of cutting height and cutting interval on quality of Ubon paspalum in 1998 (Trial 1).

| Cutting interval (d) | CP | P | K | NDF | ADF |
|---|---|---|---|---|---|
| | | | (%) | | |
| 20 | 6.8 a[1] | 0.32 a | 3.04 a | 64.9 b | 37.8 b |
| 30 | 5.9 a | 0.30 a | 3.06 a | 66.2 b | 37.8 b |
| 60 | 4.1 b | 0.25 b | 2.35 b | 68.6 a | 40.6 a |
| Cutting height (cm) | | | | | |
| 0 | 6.1 a | 0.31 a | 2.96 a | 65.9 b | 38.0 a |
| 10 | 5.3 a | 0.28 ab | 2.77 a | 66.2 a | 38.6 ab |
| 20 | 5.5 a | 0.26 b | 2.72 a | 67.6 a | 39.7 b |

[1]Within columns and treatments, means followed by a common letter are not significantly different at $P = 0.05$ by Duncan's Multiple Range Test.

Increases in cutting interval and cutting height increased stubble DM per plant and root DM per plant (Table 5).

**Table 5.** Effect of cutting height and cutting interval on Ubon paspalum plant stubble and plant root dry matter after final cutting at 120 days (Trial 1).

| Cutting interval (d) | Cutting height (cm) | | |
|---|---|---|---|
| | 0 | 10 | 20 |
| | | Stubble DM/plant (g) | |
| 20 | 7.45 | 10.9 | 28.0 |
| 30 | 15.2 | 24.2 | 41.3 |
| 60 | 50.9 | 30.2 | 64.0 |
| | | Root DM/plant (g) | |
| 20 | 26.2 | 38.8 | 56.3 |
| 30 | 43.7 | 29.0 | 55.7 |
| 60 | 51.7 | 39.8 | 74.3 |

### *Trial 2. 1999. Effect of cutting interval*

In Trial 2, total DM yield increased steadily as the interval between harvests increased but differences were significant ($P < 0.05$) only between 20 and 60 days in Period 1 and between 20 and 40 plus 60 days in Period 2 (Table 6). When both periods were combined, 60-day intervals produced more total DM than a 20-day cutting interval. Peak DM yields were 28 t/ha produced from four 60-d cutting intervals. Leaf DM yield increased as harvest interval increased but differences were significant ($P < 0.05$) only between 20 and 60 days in both Period 2 and the combined Periods 1 and 2. Stem DM yield was increased as cutting interval increased, with overall yield higher with 40- or 60-d cutting than with more frequent harvests.

Increasing the interval between harvests progressively increased the height of plants at harvest (Table 7). Crude protein concentrations in both leaf and stem material declined progressively as the interval between harvests increased (Table 7). Crude protein concentrations in leaf and whole plant material exceeded 7% when harvests were made at least every 30 days in Period 1 and every 40 days in Period 2. Even when cut every 60 days, leaf crude protein was 6.4–6.9%.

## Discussion

In a cut-and-carry forage system, the two main issues to be addressed are how high to cut and how often to cut. In these trials, cutting height affected total DM yield and leaf DM yield only when Ubon paspalum was cut every 20 days. Cutting at 20 cm every 20 days in Trial 1 produced significantly more total DM and leaf DM yields than cutting to ground level and similar yields to cutting at all heights every 30 days. Cutting every 20 days at ground level drastically reduced the plant's stubble and root reserves compared with cutting at 10 or 20 cm (Table 5) which slowed down the recovery rate of Ubon paspalum after cutting. When cut to ground level every 20 days, stubble and root reserves were less than half the reserves remaining after cutting at 20 cm every 20 days.

The cutting interval for Ubon paspalum was the most critical issue, having significant impacts on yields of total DM, leaf DM and stem DM and forage quality. Frequent cutting greatly reduced yields but increased forage quality. In Trial 1, cutting every 20 days over a 120-d period produced 53% (7t/ha) of the total DM yield obtained by cutting every 60 days (13.2t/ha) but crude protein, P and K concentrations were higher and fibre concentrations (NDF and ADF) lower. In Trial 2, cutting every 20 days over a 240-d period