

COSTA, N.L., PAULINO, V.T. e MAGALHÃES, J.A. Effects of cutting regimes on forage yield and chemical composition of *Leucaena leucocephala*. **PUBVET**, Londrina, V. 8, N. 20, Ed. 269, Art. 1791, Outubro, 2014.



PUBVET, Publicações em Medicina Veterinária e Zootecnia.

Effects of cutting regimes on forage yield and chemical composition of *Leucaena leucocephala*

Newton de Lucena Costa¹, Valdinei Tadeu Paulino², João Avelar Magalhães³

¹Eng. Agr., D.Sc., Pesquisador da Embrapa Roraima, Boa Vista, RR.

²Eng. Agr., D.Sc., APTA, Instituto de Zootecnia, Nova Odessa, SP.

³Méd. Vet., D.Sc., Pesquisador da Embrapa Meio-Norte, Parnaíba, PI.

Abstract

The effect of cutting frequencies (42, 54, 70 and 84 days) and stubble height (30, 50 and 80 cm) on forage yield and chemical composition of leucaena (*Leucaena leucocephala* cv. Cunningham) were evaluated under field conditions. Cutting frequency at 84 days, with 50 or 80 cm stubble height, provided the higher ($P<0.05$) dry matter (DM) yields. Forage production decreased when cutting intensity was increased from 50 to 30 cm. For cutting frequency at 54, 70 and 84 days, the higher DM yields were obtained with 50 cm stubble height; while at 42 days cutting interval, stubble height of 80 cm provided the highest forage production. Edible forage increased significantly ($P<0.05$) with increase in the cutting frequency from 42 to 84 days. For 30 and 50 cm stubble height, it was found that 84 or 70 days cutting interval showed maximum DM yields. Cutting frequency and stubble height greatly influenced ($P<0.05$) CP content and IVDMD. The CP content and IVDMD were highest when the herbage was harvested each 42 or 54 days at 80 cm stubble height.

The lowest CP content was obtained at 84 days interval, independently of stubble height. The main reason for increase in CP content and IVDMD values with infrequent cuts may be due to the age of the cut material. This report showed that harvesting crop for forage purpose between 70 and 84 days at 50 cm stubble height provided higher forage yields and appears to be ideal so as to succulent green forage with higher dietary nutrients.

Index terms: crude protein, dry matter, digestibility

Efeitos de regimes de corte sobre a produção e composição química da forragem de *Leucaena leucocephala*

Resumo

Os efeitos da frequência (42, 54, 70 e 84 dias) e altura de corte (30, 50 e 80 cm) sobre o rendimento de matéria seca (MS) e composição química da leucena (*Leucaena leucocephala* cv. Cunningham) foram avaliados em condições de campo. Cortes a cada 84 dias e a 50 ou 80 cm de altura forneceram os maiores rendimentos de MS. A produção de forragem decresceu com o aumento da intensidade de corte para 50 ou 30 cm de altura. Para cortes a cada 54, 70 e 84 dias, os rendimentos mais elevados de MS foram obtidos com 50 cm de altura, enquanto que para intervalos de 42 dias, a intensidade de corte de 80 cm proporcionou maior produção de MS. O rendimento de forragem comestível foi incrementado significativamente ($P < 0,05$) com o aumento da frequência entre cortes de 42 a 84 dias. Para cortes a 30 ou 50 cm de altura, os máximos rendimentos de MS foram registrados com frequências de 84 ou 70 dias. Os regimes de cortes afetaram significativamente ($P < 0,05$) os teores de proteína bruta (PB) e a digestibilidade *in vitro* da MS (DIVMS). Cortes a cada 42 ou 54 dias e a 80 cm de altura forneceram os maiores teores de PB e DIVMS. Independentemente da intensidade de corte, os menores teores de PB foram obtidos com intervalos de 84 dias. A utilização de frequências entre cortes de 70 ou 84 dias e a 50 cm

COSTA, N.L., PAULINO, V.T. e MAGALHÃES, J.A. Effects of cutting regimes on forage yield and chemical composition of *Leucaena leucocephala*. **PUBVET**, Londrina, V. 8, N. 20, Ed. 269, Art. 1791, Outubro, 2014.

acima do solo permite a obtenção de elevadas produções de forragem com alto valor nutritivo.

Termos para indexação: digestibilidade, matéria seca, proteína bruta

Introduction

In Amazonia, cattle production is limited by low availability and poor quality of pastures, mainly during the dry season. As beef and milk industries develop in the state, the need for a year-round supply of high quality forage becomes increasingly. Legumes give high forage yields and high nutritive value. *Leucaena* is the mostly widely used species as a valuable fodder shrub for increased animal production in the tropics (Khamseekhiew et al., 2001). It is an ever green forage rich in protein, minerals and B carotene. The plant can also be grazed directly, is well accepted by livestock, particularly goats and is quite resistant to heavy, frequent defoliation (Meissner, 1997). In order to bridge the gap between demand and supply of high forage, *Leucaena leucocephala* has been extensively propagated for eco-regeneration. *Leucaena* appears to have potential as a rich source of protein for cattle, mainly during the dry season. However, legumes must have adequate management to increase forage yields and pasture quality.

Cutting frequency has a major effect on the proportion of edible forage and wood production. Longer intervals are appropriate if wood is the preferred by-product, while shorter intervals are required to optimise leaf production, while cutting intensity affects the amount of leaf and stem remaining after defoliation. Although very low cutting heights may have a detrimental effect on subsequent regrowth of some species, the effect of cutting height on subsequent productivity is often neutral and sometimes positive (Duguma et al., 1988; Meléndez et al., 1986). The effect of defoliation on yield can be delineated into three distinct phases. The first is a commonly observed lag phase after cutting (weeks 0-4) when regrowth is slow due to low leaf area. This is followed by a period of maximum productivity (weeks 4-10) when leaf production increases markedly. The sigmoidal curve then plateaus as full light

interception is approached and older leaves begin to senesce (weeks 10-24). Guevarra et al. (1978) reported that leucaena did not reach full light interception until 3 months after planting. This period may be shorter when cutting well established trees or very dense plantings.

This study assessed the effects of cutting frequency and stubble height on forage yield and chemical composition of leucaena (*Leucaena leucocephala* cv. Cunningham).

Material and Methods

The trial was carried out under field conditions without supplemental irrigation at the Experimental Station of Presidente Médice, Rondônia, Brazil. The mean annual rainfall is 2.200 mm and rainy season occurs between October and May. The soil was a red-yellow Podzol (Ultisol), clayey, with pH = 5.9; P = 2 mg/kg; Ca + Mg = 4.8 cmol/dm³ and K = 74 mg/kg. A split-plot design with three replicates was used. Main plots consisted of four cutting frequency (42, 54, 70 and 84 days); and sub-treatments were three stubble height (30, 50 and 80 cm).

The leucaena seeds were scarified with hot water (80°C) for 10 min and inoculated with a specific *Rhizobium* for *Leucaena leucocephala*. Leucaena cv. Cunningham was drilled in rows at 1.0 m apart, distributing 8-10 seeds per linear meter. The total area received 22 kg of P/ha as triple superphosphate. During experimental period, forage was harvested 14, 10, 8 and 6 times, respectively to 42, 54, 70 and 84 days cutting frequency. At each harvest, fresh harvested material was weighted, and two 800 g subsamples per plot were separated by hand into forage useful fraction (leaves, flowers, pods, and branches with diameter less than 6 mm) and hard-stem fraction. These samples were dried to constant moisture at 65°C to determine percent of dry matter (DM) and *in vitro* DM digestibility (IVDMD). Total N content was determined by micro-Kjeldhal method, while IVDMD was estimated by technique described by Tilley and Terry (1963).

Results and Discussion

Edible forage was significantly affected by cutting frequency and stubble height. The data clearly indicate that forage production decreased when cutting intensity was increased from 50 to 30 cm (Table 1). For cutting frequency at 54, 70 and 84 days, the higher DM yields were obtained with 50 cm stubble height; while at 42 days cutting interval, stubble height of 80 cm provided the highest forage production.

Table 1. Effect of cutting frequency and stubble height on edible forage (t/ha) of leucaena.

Cutting frequency (days)	Stubble height (cm)			Mean
	30	50	80	
42	C 17.22 c	C 23.87 b	C 26.60 a	22.56
54	B 21.31 b	B 29.78 a	C 28.49 a	26.53
70	A 24.74 c	A 34.92 a	B 31.26 b	30.31
84	A 25.11 c	A 37.05 a	A 33.88 b	32.01
Mean	22.10	31.40	26.64	

- Means for the same row or column are statistically equal if followed by the same lower case letter or capital letter, respectively, at the 5% probability by Tukey's test.

Edible forage increased significantly with increase in the cutting frequency from 42 to 84 days. For 30 and 50 cm stubble height, it was found that 84 or 70 days cutting interval showed maximum DM yields. However, cutting at 80 cm height gave the highest forage production at 84 days interval. The average data showed that at 50 cm stubble height, forage production increased by 42 and 18% over that obtained at 30 and 80 cutting heights, respectively. The lowest edible forage was obtained at 30 cm stubble height at 42 days cutting frequency. This may be attributed to relatively little space on the shoot for branching leading to increased browse production. At longer cutting interval it is expected that there will be a decrease in leaf to stem ratio resulting from an increase in stem portion as the plant ages. The edible forage recorded in this study was higher than those reported by Cordovi and Arias (1984), Meléndez et al. (1986) and Costa and Paulino (1990). Similarly, Krishnamurthy and Gowda (1982) found that plots of leucaena clipped at 75 cm stubble height each 50 or 60 days had higher DM yields and tree survival

COSTA, N.L., PAULINO, V.T. e MAGALHÃES, J.A. Effects of cutting regimes on forage yield and chemical composition of *Leucaena leucocephala*. **PUBVET**, Londrina, V. 8, N. 20, Ed. 269, Art. 1791, Outubro, 2014.

than plots clipped at 15 or 150 cm stubble height each 40 days. González et al. (2003) reported increases more than 120% in forage yield of leucaena cut at intervals of 49 days, compared to 21 or 35 days. However, Pathak et al. (1980) found no significant difference in forage production when leucaena was cut at 10, 20 or 30 cm stubble height each 40, 60 or 120 days. According to Crowder and Chedda (1982) cutting near ground level increases total and seasonal edible forage over a short period as compared to more elevated cutting, but plants are adversely affected in the same way as to frequent harvesting. Tipu et al. (2006) showed that higher pruning heights (150 cm) had a significantly higher number of branches, length of branches and leaves per plant of leucaena than those of lower heights (50 cm).

Several authors have reported that as cutting intervals increase, woody stems comprise a larger proportion of a tree's dry matter production (Guevarra et al., 1978; Duguma et al., 1988; Ella et al., 1989; Muir, 1998; Aminah and Wong, 2004). The same trend was found in the present study. These results illustrate the importance of adjusting the length of cutting intervals in order to maximize production of the desired output, for example, edible fodder versus fuel wood. Latt et al. (2000) reported that frequent cutting in leucaena will decrease, and eventually deplete, reserve carbohydrates. This will decrease biomass production and contribute to tree mortality. A longer cutting interval is preferable. Some researchers have found that higher cutting heights produced higher yields (Krishnamurthy and Gowda, 1982) with leucaena. Isarasenee et al. (1984) reported enhanced growth of leucaena cut at 120 cm compared with 60 or 30 cm. They further suggested that early regrowth was supported by movement of carbohydrate reserves from stem rather than from current photosynthesis. A low cutting height of 5 cm was detrimental to both yield and persistence of *Codariocalyx gyroides* (Lazier, 1981). On the other hand, Ferraris (1979) found no difference in the yields of leucaena cut at 10 or 30 cm. A wider range of cutting heights (30, 60 and 90 cm) for leucaena also did not affect yield in an experiment conducted by Jama and Nair (1989). Cutting

height was, however, positively related to shoot number per plant and this was also observed in the trial by Pathak et al. (1980).

Cutting frequency and stubble height greatly influenced CP content and IVDMD (Tables 2 and 3). The CP content and IVDMD were highest when the herbage was harvested each 42 or 54 days at 80 cm stubble height. The lowest CP content was obtained at 84 days interval, independently of stubble height. The main reason for increase in CP content and IVDMD values with infrequent cuts may be due to the age of the cut material. Similarly, Cordovi and Arias (1984) and Krishnamurthy et al. (1986) observed that leucaena plants clipped at 30 or 45 days showed greater CP content than plants clipped at 60 or 70 days. Aminah and Wong (2004) found significant reductions in leucaena CP levels with decreasing cutting frequency (29.6; 24.3 and 21.9%, respectively to cutting intervals of 8, 10 and 12 weeks).

Table 2. Effect of cutting frequency and stubble height on crude protein content of leucaena edible forage.

Cutting frequency (days)	Stubble height (cm)			Mean
	30	50	80	
42	19.99	22.05	23.57	21.87 a
54	19.26	20.12	21.70	20.36 a
70	15.34	18.17	18.81	17.44 b
84	14.61	14.72	16.30	15.21 c
Mean	17.30 b	18.77 b	20.10 a	

- Means followed by the same letters are not significantly different at the 5% probability by Tukey's test.

Table 3. Effect of cutting frequency and stubble height on *in vitro* dry matter digestibility of leucaena edible forage.

Cutting frequency (days)	Stubble height (cm)			Mean
	30	50	80	
42	57.15	59.00	60.18	58.78 a
54	56.02	56.22	58.07	56.77 ab
70	53.11	52.71	55.10	53.64 bc
84	51.32	50.09	53.13	51.51 c
Mean	54.40 b	54.50 b	56.62 a	

- Means followed by the same letters are not significantly different at the 5% probability by Tukey's test.

COSTA, N.L., PAULINO, V.T. e MAGALHÃES, J.A. Effects of cutting regimes on forage yield and chemical composition of *Leucaena leucocephala*. **PUBVET**, Londrina, V. 8, N. 20, Ed. 269, Art. 1791, Outubro, 2014.

Conclusion

Productivity and chemical composition of leucaena forage are affected by cutting intensity and frequency. This report showed that harvesting crop for forage purpose between 70 and 84 days at 50 cm stubble height provided higher forage yield and appears to be ideal so as to succulent green forage with higher dietary nutrients.

References

- AMINAH, A.; WONG, C.C. Dry matter productivity and nutritive quality of leucaena hybrid lines for high protein feed production. **Journal of Tropical Agriculture and Food Science**, v.32, n.2, p.251-256, 2004.
- CORDOVI, E.; ARIAS, R. Estudio comparativo de variedades de leucaena (*Leucaena leucocephala*). **Ciencia Técnica en Agricultura**, v.7, n.1, p.17-26, 1984.
- COSTA, N. de L.; PAULINO, V.T. Comparative performance of four leucaena cultivars in an ultisol. **Leucaena Research Reports**, v.11, p.37-38, 1990.
- CROWDER, L.V.; CHEDDA, H.R. **Tropical grassland husbandry**. Longman, New York. 1982. 562p.
- DUGUMA, B.; KANG, B.; OKALI, D.U.U. Effect of pruning intensity of three woody leguminous species grown in alley cropping with maize and cowpea on an alfisol. **Agroforestry Systems**, v.6, p.19-35, 1988.
- ELLA, A.; JACOBSEN, C.; STÜR, W.W.; BLAIR, G. Effect of plant density and cutting frequency on the productivity of four tree legumes. **Tropical Grasslands**, v.23, n.1, p.28-34, 1989.
- FERRARIS, R. Productivity of *Leucaena leucocephala* in the wet tropics of North Queensland. **Tropical Grasslands**, v.13, n.1, p.20-25, 1979.
- GONZÁLEZ, I.; FARÍA, J.; MORILLO, D.; MAVAREZ, O.; NOGUERA, N. Efecto de frecuencias de riego y corte sobre el rendimiento de materia seca en *Leucaena leucocephala* (Lam.) De Wit. **Revista de la Facultad de Agronomía**, v.20, n.3, p.23-31, 2003.
- GUEVARRA, A.B.; WHITNEY, A.S.; THOMPSON, J.T. Influence of intra-row spacing and cutting regimes on the growth and yield of *Leucaena*. **Agronomy Journal**, v.70, p.1033-1037, 1978.
- ISARASENEE, A.; SHELTON, H.M.; JONES, R.M.; BUNCH, G.A. Accumulation of edible forage of *Leucaena leucocephala* cv. Peru over late summer and autumn for use as dry season feed. **Leucaena Research Reports**, v.5, p.34-38, 1984.
- JAMA, B.; NAIR, P.K.R. Effect of cutting height of *Leucaena leucocephala* hedges on production of seeds and green leaf manure at Machakos, Kenya. **Leucaena Research Reports**, v.10, p.46-48, 1989.
- KHAMSEKHEW, B.; LIANG, J.B.; WONG, C.C.; JALAN, Z.A. Ruminant and intestinal digestibility of some tropical legume forages. **Asian-Australia Journal of Animal Science**, v.14, p.321-325, 2001.
- KRISHNAMURTHY, M.K.; GOWDA, M.K. Effect of cutting and frequency regimes on the herbage yield of leucaena. **Leucaena Research Reports**, 3:31-32, 1982.

KRISHNAMURTHY, M.K.; GOWDA, M.K.; RAMAKRISHNAPPA, K. Influence of frequency and cutting regimes on the growth and yield of *Leucaena leucocephala* (L.) de Wit. **Mysore Journal of Agriculture Science**, v.20, p.89-98, 1986.

LATT, C.R.; NAIR, P.K.R.; KANG, B.T. Interactions among cutting frequency, reserve carbohydrates, and post-cutting biomass production in *Gliricidia sepium* and *Leucaena leucocephala*. **Agroforestry Systems**, v.50, p.27-46, 2000.

LAZIER, J.R. Effect of cutting height and frequency on dry matter production of *Codariocalix gyroides* (syn. *Desmodium gyroides*) in Belize, Central America. **Tropical Grasslands**, v.15, n.1, p.10-16, 1981.

MEISSNER, H.H. Recent research on forage utilization by ruminant livestock in South Africa. **Animal Feed and Science Technology**, v.69, p.103-119, 1997.

MELÉNDEZ, J.L.; SOLARANA, J.L.; GIRAUD, G.I.; ACOSTA, N.A.; ANDRADE, R.C. Influencia de la frecuencia de corte y la época del año sobre la composición mineral y los rendimientos de la *Leucaena leucocephala* cv. Perú. **Revista de Producción Animal**, v.2, n.3, p.203-210, 1986.

MUIR, J.P. Effect of cutting height and frequency on *Leucaena leucocephala* forage and wood production. **African Journal of Range & Forage Science**, v.15, n.1, p.7-10, 1998.

PATHAK, P.S.; RAI, P.; ROY, R.D. Forage production from koo-babool (*Leucaena leucocephala* (Lam.) de Wit). I. Effect of plant density, cutting intensity and interval. **Forage Research**, v.6, p.83-90, 1980.

TILLEY, J.M.A.; TERRY, R.A. A two-stage technique for the *in vitro* digestion of forage crops. **Grass and Forage Science**, v.18, p.104-111, 1963.

TIPU, S.U.; HOSSAIN, K.L.; ISLAM, M.O.; HOSSAIN, M.A. Effect of pruning height on shoot biomass yield of *Leucaena leucocephala*. **Asian Journal of Plant Science**, v.5, n.6, p.1043-146, 2006.