ID # 01-32

# EFFECT OF CUTTING HEIGHT ON TILLER POPULATION DENSITY AND HERBAGE BIOMASS OF BUFFEL GRASS

L.S. Beltrán, P.J. Pérez, G.A. Hernández, M.E. García, S.J. Kohashi and H.J.G. Herrera

Instituto de Recursos Naturales. Colegio de Postgraduados, México, sbeltran@colpos.colpos.mx

## Abstract

The aim of this trial was to investigate the effect of different cutting heights on tiller population density and herbage biomass of Buffel grass (*Cenchrus ciliaris* L) grown in miniature swards in a greenhouse. Four treatments with five replicates: five cm, ten cm, and 20 cm cutting height, and control (without cut) were randomly allocated. Intensity of defoliation affected the cumulative herbage harvested; the ten cm cutting height was greater (404.1 g DM $m^{-2}$) than 5 cm (317.6 g DM $m^{-2}$) and 20 cm (263.9 g DM $m^{-2}$), respectively. Cumulative herbage harvested in the control, increased progressively until September; from then onwards tended to decrease. At the end of the trial, the highest tiller population density was found at five cm cutting height with 28 %, 48 % and 71 % more tillers than ten cm, 20 cm and control, respectively. Herbage mass at five cm and ten cm cutting height, were greater for tiller population density and herbage harvested than 20 cm and control ($\alpha<0.05$).

**Keywords**: Buffel (*Cenchrus ciliaris* L), defoliation, tiller population density, Herbage harvested

## Introduction

Buffel grass (*Cenchrus ciliaris* L) is African specie introduced to Mexico and two million ha is currently established (Ibarra, et al., 1991). This grass has been favored for its great potential for the semiarid lands, due to high tolerance to drought, high yield, easy establishment and good response to grazing management. However, important losses occur every year, due to inadequate management, especially overgrazing. The main factor that affects the growth, yield and persistence of swards, is the defoliation intensity. The severity of defoliation causes physiological and morphological changes at plant level, especially during the regrowth period (Briske, 1986). The regrowth after defoliation, is one of the most important physiological processes, and it determines the sward structure (Matthew *et al*, 1995). The higher leaf area index of a pasture promotes the greater incident radiation interception at the canopy and during regrowth; pasture growth rate increases until the point where 95-100 % of incident light is intercepted (Mott, 1981; Chapman and Lemaire, 1993). Intense grazing usually increases tiller density and induces a high irradiation interception in the swards (L'Huillier, 1987), however a balance should exist in the growth-defoliation relationship, because an intense grazing might seriously limit grass growth, due to the low amount of the remaining leaf area (Matthew *et al*., 1995). Leaf size is highly responsive to variation in defoliation intensity, owing simply to increased stocking rate, or to differences in defoliation patterns associated with different grazing methods (Chapman y Lemaire, 1993). Korte and Parson (1984) postulated that small tillers would be more tolerant to intensive grazing regime by virtue of their ability to retain a greater proportion of leaves below the grazing horizon and thus maintain a more stable supply of assimilates for regrowth. According to Hernandez *et al* (1999) herbage biomass is a function of the height defoliation, tiller weight and tiller population density. The aim of this study was to

investigate the effect of cutting height intensities on tiller population density and herbage harvested in Buffel grass.

## Material and Methods

Miniature swards of Buffel grass (*Cencrhus ciliaris* L), were established from seed in plastic pots 25 cm of diameter and 20 cm depth, in may 1998 and grown in a greenhouse at Palma de la Cruz (INIFAP) research station, San Luis Potosi, Mexico (22º 12' 00'' N, 100º 55'18'' W). The experimental period was ten months duration (may 1998 to march 1999). The pots were randomly allocated to four treatments (five, ten, 20 cm cutting heights and the control (without cut), with five replications. Each pot contained four kg of sandy loam soil. The sowing rate was equivalent to 3 kg seed $ha^{-1}$. Once the seedlings were established, 40 kg $ha^{-1}$ of nitrogen was supplied, equivalent to 3.0 g per pot as urea. Each pot was watered daily. Clippings began when the plants had reached 25 cm height (26 May 1998), 40 days after seedling (16 April 1998). Afterwards, clipping was done every week, according to the cutting height. Herbage harvested was collected, dried at 65 ºC and weighed. Tiller population density was recorded weekly. Data were submitted to analysis of variance ($\alpha<0.05$) using the General Linear Model (GLM) procedure of SAS (SAS, Institute Inc. 1991).

## Results and Discussion

There were statistical differences among treatments in cumulative herbage biomass ($\alpha<$ 0.05). From the beginning to September, cumulative herbage mass was higher under the control, however, from then onwards; it decreased, whereas it increased under the other treatments. At the end of the trial, cumulative herbage mass was ranked as follow: ten cm > five cm > 20 cm cutting

height > control, respectively (Figure 1). The low herbage harvested in control, might be a consequence of increased leaf senescence. In this sense, Hunt (1970) mentions losses by senescence and decomposition increase to a maximum during uninterrupted growth of a sward. The highest cumulative herbage biomass under 10 cm cutting height may be due to higher single tiller weight, just as Hernandez *et al*, (1999) refers to the highest herbage harvested being a function of the height of defoliation, tiller weight and tiller population density. The weekly herbage harvested for ten and five cm increased steadily from november until the end of the study.

Tiller population density, at the beginning of the experiment (26 May 1998), averaged 172 tillers $m^{-2}$. Tiller population density increased progressively in all treatments, from March (1998) until January (1999). From then onwards tended to decrease at 20 cm cutting height and control (Table 1). At the end of the trial (February - March, 1999), tiller population density was highest at five cm cutting height (2343 tiller $m^{-2}$). Treatments were ranked as follow: five cm > ten cm > 20 cm > control, respectively. This behavior can be explained by the size-density compensation index, where the least size of tillers, is compensated by the high tiller population density (Hernández, *et al*. 1999). According to Chapman and Lemaire (1993), when severity of defoliation increases, morphological adjusts are needed to ensure homeostatic whole plant growth. The higher herbage harvested on ten cm cutting height may be explained by the higher single tiller weight. In this trial the more severe treatments (ten and five cm), probably caused morphological changes at plant level. In summary, the different cutting heights affect the tiller population density and herbage biomass of Buffel grass.

## References

**Briske, D.D.** (1986). Plant response to defoliation: morphological considerations and allocation

priorities. In: Joss, P. J., Lynch, P. W., Williams, O. B. Eds. Rangelands: A resource under siege. Cambridge, Univ. Press. Pp 425-427.

**Chapman, D.F and Lemaire G.** (1993). Morphogenetic and structural determinants of plant regrowth after defoliation. Proceedings of the XVII International Grassland Congress p. 95 - 104.

**Hernández, G.A., Matthew C. and Hodgson J.** (1999). Tiller size/density compensation in perennial ryegrass miniature swards subject to differing defoliation heights and a proposed productivity index. Grass and Forage Science **54**: 347-356.

**Hodgson, J., Bircham J.S., Grant S.A. and King J.** (1981). The influence of cutting and grazing management on herbage growth and utilization. In: Wright, C. E. Ed. Plant physiology and herbage production. The British Grassland Society. Occasional Symposium. Number **13**: 51-62.

**Hunt, W.F.** (1970). The influence of leaf death on the rate of accumulation of green herbage during pasture regrowth. Journal of Applied Ecology. **7**: 41-50.

**Korte, C.J. and Parsons A.J.** (1984). Persistence of a large-leaved white clover variety under sheep grazing. Proceedings of the New Zealand Grassland Association. **45**: 118-123.

**L' Huiller, P.J. (**1987). Effect of dairy cattle stocking rate and degree of defoliation on herbage accumulation and quality in ryegrass-white clover pasture. New Zealand Journal of Agricultural Research **30**: 149-157.

**Ibarra, F.F.A.** (1991). Utilización, manejo y mejoramiento de praderas de zacate buffel. En memorias del taller sobre captación y aprovechamiento del agua con fines agropecuarios. SARH - INIFAP Comarca Lagunera. P. 191 - 200

**Matthew, C., Lemaire G., Sackville N.R. Hamilton A. and Hernández G**. (1995). A modified self-thinning equation to describe size/density relationships for defoliated swards. Annals of botany **76**: 579-587.

**Mott, G.O.** (1981). Potential productivity of temperate and tropical grassland systems. Proceedings of the XIV International Grassland Congress: 35 - 41.

**SAS Institute Inc.** (1995). User's guide. Statistics. Version 6. Forth edition. SAS Inc. Cary, North Carolina, USA. 956 p.

**Table 1 -** Effect of cutting height on tiller population density (tillers $m^{-2}$) of miniature swards of Buffel grass

| Cutting | 1998 | | | | | | | | 1999 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Height (cm) | M | J | J | A | S | O | N | D | J | F | M |
| 5 | 187 | 302 | 391 | 654 | 877 | 1069 | 1014 | 1409 | 1571 | 2266 | 2343 |
| 10 | 165 | 304 | 407 | 791 | 1152 | 1442 | 1447 | 1897 | 2019 | 1917 | 1686 |
| 20 | 171 | 299 | 405 | 709 | 1003 | 1240 | 1234 | 1293 | 1209 | 1126 | 1217 |
| Control | 162 | 254 | 317 | 529 | 759 | 994 | 1143 | 1149 | 1008 | 811 | 686 |
| s.e.m. | 0.52 | 0.74 | 1.26 | 3.16 | 4.99 | 7.29 | 7.63 | 7.20 | 9.53 | 10.04 | 10.51 |
| Significance | ns | * | * | * | * | * | * | * | * | * | * |

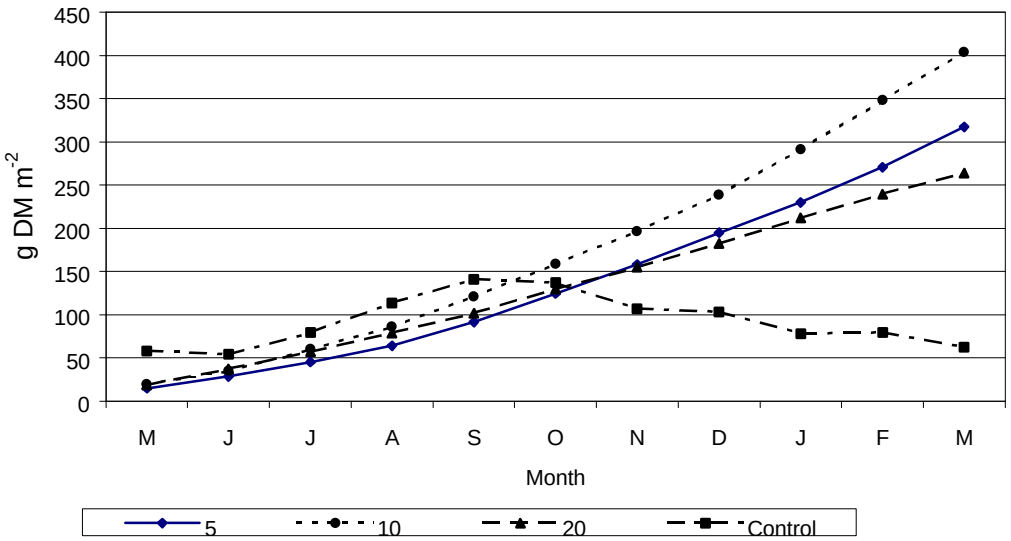


**Figure 1 –** Effect of cutting height on cumulative herbage biomass of Buffel grass miniature swards (1998-1999).