Revista Brasileira de Zootecnia
© 2006 Sociedade Brasileira de Zootecnia
ISSN impresso: 1516-3598
ISSN *on-line*: 1806-9290
www.sbz.org.br

R. Bras. Zootec., v.35, n.2, p.334-342, 2006

Grazing management strategies for massaigrass-forage peanut pastures. 1. Dynamics of sward condition and botanical composition[1]

Carlos Mauricio Soares de Andrade[2], Rasmo Garcia[3], Judson Ferreira Valentim[2], Odilon Gomes Pereira[3]

[1] Part of the Doctorate thesis of the first author, with financial support by Fapemig and Embrapa.
[2] Embrapa Acre, CP 321, CEP: 69908-970, Rio Branco, AC.
[3] Animal Science Department, UFV, granted by CNPq.

ABSTRACT - This study was carried out from October 2002 to December 2003 to evaluate the dynamics of sward condition and botanical composition of a mixed massaigrass (*Panicum maximum* x *P. infestum*, cv. Massai) and forage peanut (*Arachis pintoi* Ac 01) pasture, intermittently stocked at three daily herbage allowance levels (9.0, 14.5 and 18.4% live weight). Sward condition was characterized in each grazing cycle in terms of the pre- and post-grazing sward height, forage mass and percentage of bare ground. Botanical composition (grass, legume and weeds) was evaluated before each grazing period. Sward height and forage mass increased linearly with increasing herbage allowance (HA) levels, and higher values were observed during the rainy season. Percentage of bare ground increased primarily at the lowest HA level. Percentage of forage peanut increased throughout the experimental period, primarily in the barest and shortest swards, under the lowest HA level. In the last quarter of 2003 the legume constituted 23.5, 10.6 and 6.4% of the pasture forage mass, respectively, from the lowest to the highest HA level. These results suggest that forage peanut can be successfully associated with massaigrass, as long as the pre-grazing sward height is maintained shorter than 65-70 cm, which will prevent excessive shading to the legume.

Key Words: *Arachis pintoi*, competition, legume, *Panicum maximum*, persistence, Western Amazon

Estratégias de manejo do pastejo para pastos consorciados de capim-massai e amendoim forrageiro. 1. Dinâmica da condição do pasto e da composição botânica

RESUMO - Este estudo foi realizado com o objetivo de avaliar a dinâmica e a composição botânica de uma pastagem consorciada de capim-massai (*Panicum maximum* x *P. infestum*, cv. Massai) e amendoim forrageiro (*Arachis pintoi* Ac 01), manejada sob lotação rotacionada em três níveis de oferta diária de forragem (9,0; 14,5 e 18,4% do peso vivo). A condição da pastagem foi caracterizada em cada ciclo de pastejo, em termos de altura, massa de forragem e porcentagem de solo descoberto (pré e pós-pastejo). A composição botânica da pastagem (gramínea, leguminosa e invasoras) foi monitorada antes de cada período de ocupação. Houve aumento linear da altura e da massa de forragem da pastagem com o incremento dos níveis de oferta de forragem (OF), observando-se maiores valores durante o período de máxima precipitação. A porcentagem de solo descoberto, por sua vez, aumentou, principalmente no menor nível de OF. A porcentagem de amendoim forrageiro aumentou progressivamente ao longo do período experimental, sobretudo nas pastagens mantidas com dossel mais baixo e mais aberto, criado com o uso de menores níveis de OF. No último trimestre do período experimental, a leguminosa representou 23,5; 10,6 e 6,4% da massa seca da pastagem, respectivamente, do menor para o maior nível de OF. Estes resultados sugerem que o amendoim forrageiro pode ser consorciado satisfatoriamente com o capim-massai, desde que a altura da pastagem na condição pré-pastejo seja mantida abaixo de 65-70 cm para evitar o sombreamento excessivo da leguminosa.

Palavras-chave: Amazônia Ocidental, *Arachis pintoi*, competição, leguminosa, *Panicum maximum*, persistência

Introduction

The use of improved grass-legume pastures has been considered as one of the options to increase the productivity, profitability and sustainability of cattle production systems in tropical (Valentim & Andrade, 2004) and temperate regions (Laidlaw & Teuber, 2001). There are several successful experiences with grass-legume pastures in temperate countries, particularly in New Zealand, where mixed ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*) pastures comprise the dietary basis of the dairy cattle production systems (Caradus et al., 1996). In contrast, the successful use of grass-legume pastures in the tropics is an exception to the norm, with only a few cases reported in the literature, most of which were realized in the last two decades (Valentim & Andrade, 2004).

Correspondências devem ser enviadas para: mauricio@cpafac.embrapa.br

Important reasons for the lack of wide-spread adoption of grass-legume pastures in the tropics include: 1) unsuccessful experiences of farmers and researchers, resulting in a lack of credibility of the viability of this alternative; 2) a lack of commercial cultivars adapted to different environmental conditions; 3) low availability and high cost of commercial seeds in the market; 4) a lack of knowledge among farmers regarding adequate management of grass-legume pastures; 5) a lack of persistence of legumes in the associations with grasses; 6) a lack of farmer participation in research and development; and 7) a lack of multidisciplinary approach in forage improvement programs (Barcellos & Vilela, 1994; Spain, 1995; Mannetje, 1997; Elbasha et al., 1999; Hoveland, 1999; Barcellos et al., 2001; Pereira, 2002; Valentim & Andrade, 2004).

Arachis pintoi is currently the most promising forage legume in tropical regions, especially in humid climates. One reason for this fact is that, of all the tropical herbaceous legumes, *A. pintoi* has the highest number of favorable attributes related to persistence under grazing. Some of these attributes include: 1) a prostrate and stoloniferous growth habit; 2) a prolonged plant life span (half-life of 25 months); 3) a high production of buried seeds, which germinate vigorously in the beginning of the rainy season; and 4) high shade tolerance (Grof, 1985a, 1985b; Jones, 1993; Fisher & Cruz, 1995; Thomas, 1995; Andrade et al., 2004). In the State of Acre, in the Western Brazilian Amazon, *A. pintoi* cv. Belmonte was successfully introduced in approximately 65,000 ha of pasture, in association with various grass species (Valentim & Andrade, 2004).

Although the association of *A. pintoi* cv. Belmonte and massaigrass (*Panicum maximum* x *P. infestum*, cv. Massai) has been recommended for pasture establishment in the State of Acre (Valentim et al., 2001a, 2001b), little is known about the behavior of this mixture under grazing. To date, cultivars and accessions of *A. pintoi* have been studied under grazing in mixtures with species of *Brachiaria* (Grof, 1985a, 1985b; Pérez & Lascano, 1992; Ibrahim & Mannetje, 1998; Santana et al., 1998), *Cynodon* (González et al., 1996), and also with *Paspalum atratum* cv. Pojuca (Barcellos et al., 1999), demonstrating good persistence in all cases. However, in the only published study concerning a mixed *A. pintoi* and *Panicum maximum* pasture under grazing (Perin, 2003), results regarding the persistence of the legume were inconclusive.

The aim of this work was to evaluate the dynamics of sward condition and botanical composition of a mixed massaigrass and forage peanut pasture under grazing by steers at three daily herbage allowance levels.

Material and Methods

This experiment was carried out at the Experimental Research Station of Embrapa Acre (10°01’59" S and 67°42’13" W), in Rio Branco, AC, Brazil, between February 2002 and December 2003. Annual rainfall of 1,900 mm, a mean temperature of 25ºC and 87% mean relative humidity characterize the local climate. The experimental area consisted of a 1,800 m^2 paddock that was established in 1992 with massaigrass and planted with forage peanut (*A. pintoi* Ac 01) in 1994. The soil is classified as a Red-Yellow Argissol (pH H_2O, 6.0; P and K (Mehlich-1), 1.7 and 86.0 mg/dm^3; Ca^{2+} and Mg^{2+}, 5.15 and 0.83 $cmol_c/dm^3$; H + Al^{3+}, 2.81 $cmol_c/dm^3$; SB, 6.21 $cmol_c/dm^3$; CTC pH 7.0, 9.02 $cmol_c/dm^3$; V, 68.6%; OM, 1.90 dag/dm^3; clay, 18.3%; silt, 24.5%; sand, 57.2%). Triple super-phosphate (50 kg/ha of P_2O_5) was added to the pasture in March 2002.

Sward condition was initially characterized by excessive forage mass (9,500 kg/ha of dry matter), thus a pre-experimental treatment was conducted between February and September of 2002. During this period, the experimental area was grazed by Nelore steers under intermittent stocking system of 35 days grazing cycle (2-d grazing and 33-d rest period) at a daily herbage allowance of 15 kg DM/100 kg live weight (15% LW).

The experimental period started in October 2002, when the experimental area was subdivided in nine experimental units to implement the three daily herbage allowance levels (7, 11 and 15% LW) in a randomized complete block design with three replications. Throughout the experimental period (from October 2002 to December 2003) average daily herbage allowance levels actually applied were 9.0, 14.5 and 18.4% LW. Pastures were managed under a grazing system of intermittent stocking with 28 days grazing cycle (2-d grazing period and 26-d rest period) during the rainy season or 35 days grazing cycle (2-d grazing period and 33-d rest period) during the dry season. The experimental animals were Nelore steers with live weight from 180 to 360 kg. Animals remained in experimental units only during the 2-d grazing period, grazing an adjacent *Brachiaria brizantha* pasture during the rest period. Data from each grazing cycle were grouped into the following quarters: a) October-December, early rainy season; b) January-March, full rainy season; c) April-June, late rainy to early dry season; and d) July-September, full dry season.

Sward condition (sward height, forage mass and percentage of bare ground) was characterized immediately before and after each grazing period, except from October to December 2002 when data were obtained only before grazing. Botanical composition was evaluated immediately before each grazing period. Systematic evaluations were performed along five transects that crossed each experimental unit in a zigzag pattern. Ten sampling points per experimental unit (two per transect) were selected using a galvanized iron quadrat (100 cm x 100 cm). Within each sampling unit the following measurements were made: sward height (cm), using a ruler at three random points; percentage of bare ground (%BG), visually estimated; and botanical composition (%), visually estimated as the percentage of contribution of grass, forage peanut and weeds to the total forage mass (Whalley & Hardy, 2000).

Forage mass (kg/ha of DM) was estimated by the double sampling technique, based on sward height (cm) and ground cover (%) index (HCI = height x ground cover / 100). Calibration equations (pre- and post-grazing) were obtained by measuring sward height and ground cover, and clipping nine 1.0 m^2 quadrats (one per experimental unit) to a 10 cm stubble height. Forage samples were oven-dried at 80ºC, for 48 hours, and weighted. Sampling points were selected to represent, in each treatment, sites with high, average and low forage mass. Forage mass of each component (grass, forage peanut and weeds), in each grazing cycle, was calculated by multiplying pre-grazing total forage mass by the percentage of the respective pasture component.

Botanical composition data were adjusted by covariance to account for initial variation among plots. This adjustment was made using as covariates the percentages of massaigrass, forage peanut and weeds, which were measured within each experimental unit at the end of the pre-experimental period.

Data were subjected to the analysis of variance, according to a split-plot in time design, with main plots in a randomized complete block design. Three daily herbage allowance levels represented main plots, with four (sward condition parameters) or five (botanical composition) quarters representing subplots. Sward condition data for the first quarter (Oct/Dec 2002) were excluded as only pre-grazing condition was evaluated. Significant interactions ($P<0.05$) were conveniently brocken down. Variables showing significant effect of herbage allowance were analyzed by linear regression. The choice of the best-fit equation was based on the coefficient of determination and on the significance of the regression coefficients. Periods were compared using the Tukey test at the 5% level.

Results and Discussion

Pre- and post-grazing sward height increased linearly with increasing herbage allowance (HA) levels (Figure 1A). Over the experimental period, average pre-grazing sward heights were 58, 64 and 72 cm, and post-grazing sward heights were 34, 40 and 49 cm, from the lowest to the highest HA level, respectively. As expected, higher sward height was observed during the wettest period of the year (October to March), primarily in the pre-grazing condition (Figure 1B), as a result of favorable soil water conditions for pasture growth. On average, over the three HA levels, pre-grazing sward height varied throughout the experimental period from 57 to 73 cm, and from 38 to 44 cm in the post-grazing condition.

Variation in pre-grazing sward height was similar to that found in clipped stands of massaigrass, where mean height typically ranged from 60 to 65 cm (Valentim & Moreira, 1994; Lempp et al., 2001), with seasonal variation from 50 to 80 cm (Nascimento et al., 2002). Post-grazing sward height was slightly higher than expected, even at the lowest HA level (9.0% LW). It should be recalled that the experimental

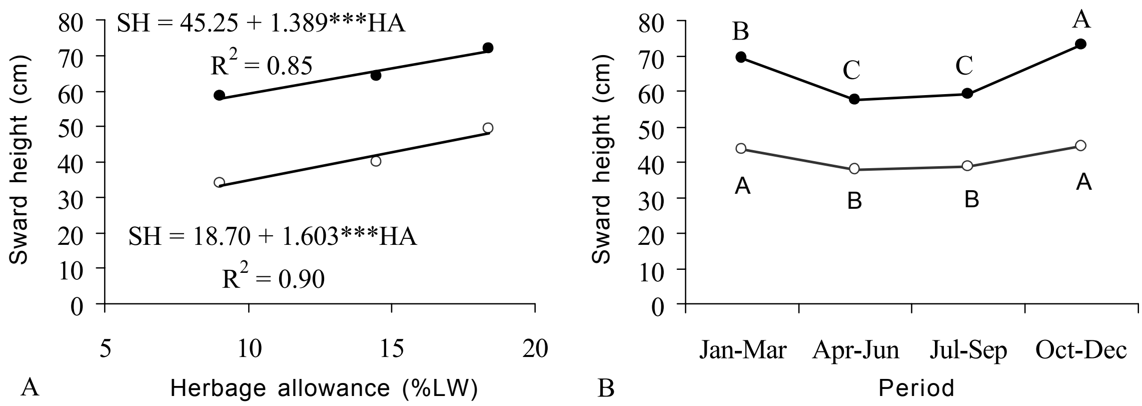

Figure 1 - Variation in pre- (?) and post-grazing (?) sward height as a function of herbage allowance (A) and period of the year (B). *** Significant by F test at the 0.1% level. Means with the same letters, for each variable, are not different by the Tukey test at the 5% level.

pasture area was established nine years before this research and presented excessive sward height and forage mass at the onset of the experiment. Despite the use of an extended pre-experimental period (seven months), it was not possible to establish shorter swards. Actual HA levels were also higher than hypothesized levels.

A quadratic relationship was found between herbage allowance and percentage of bare ground (%BG), with the highest pre- and post-grazing %BG occurring at the lowest HA level (Figure 2A). On average, over the experimental period, pastures presented 21, 14 and 15% of bare ground (pre-grazing), from the lowest to the highest HA level, respectively. Values obtained under the two highest HA levels are similar, corresponding with values found in a nitrogen fertilized massaigrass pasture in the Cerrado region of Brazil (Lempp et al., 2001). Post-grazing %BG varied from 39, 28 and 33%, from the lowest to the highest HA level, respectively (Figure 2A). The high post-grazing %BG under the highest HA level was apparently caused by the higher light restriction for growth of forage peanut (Figure 4C) and weeds (Figure 4E) in the inter-tussock spaces.

Percentage of bare ground also varied over the experimental period (Figure 2B). Pre-grazing %BG was higher in Jul/Sep, the driest period of the year when pasture growth is reduced. Post-grazing %BG was higher in Jan/Mar, declined sharply in the Apr/Jun period, and increased again with the intensification of the dry period in Jul/Sep, remaining stable in the following period (Figure 2B). This can be explained by the fact that the soil in the experimental area became waterlogged due to excessive rain in Jan/Mar, resulting in discomfort to the experimental animals, which became restless, walking excessively around the paddocks. However, the low pre-grazing %BG in this same period demonstrates the capacity of this mixed pasture, mainly of the legume, to recover from such events.

Similarly to sward height, pre- and post-grazing forage mass increased linearly with increasing HA levels (Figure 3A). Over the experimental period, average pre-grazing forage masses were 4,240, 5,740 and 6,650 kg/ha (DM), and post-grazing forage masses were 2,270, 3,540 and 4,160 kg/ha, from the lowest to the highest HA level, respectively.

Pre and post-grazing forage mass varied differently over the experimental period. Pre-grazing forage mass was higher during the wettest period of the year (October to March), declining from April to September, due to lower pasture growth (Figure 3B). Post-grazing forage mass increased from Jan/Mar to Oct/Dec. The low post-grazing forage mass in Jan/Mar was caused by the previously mentioned excessive trampling during this period. On average, over the three HA levels, pre-grazing forage mass varied over the experimental period from 4,540 to 6,520 kg/ha, and the post-grazing mass varied from 2,890 to 3,930 kg/ha. Brâncio (2000) related pre-grazing values for forage mass of a massaigrass pasture varying from 2,880 to 4,990 kg/ha, respectively, in the dry and rainy seasons in the Cerrado region of Brazil. In the same study post-grazing forage mass varied from 2,640 to 3,950 kg/ha. The pre-grazing values found in the Cerrado are lower than those obtained under the lowest HA level (3,430 to 5,250 kg/ha) in the present study, while the post-grazing values are similar to those observed at the intermediate HA level (3,260 to 4,030 kg/ha of DM). The colonisation of empty spaces by *A. pintoi* among massaigrass tussocks, and the more favorable climatic conditions for pasture growth in the State of Acre, help to explain the differences observed between the two studies.

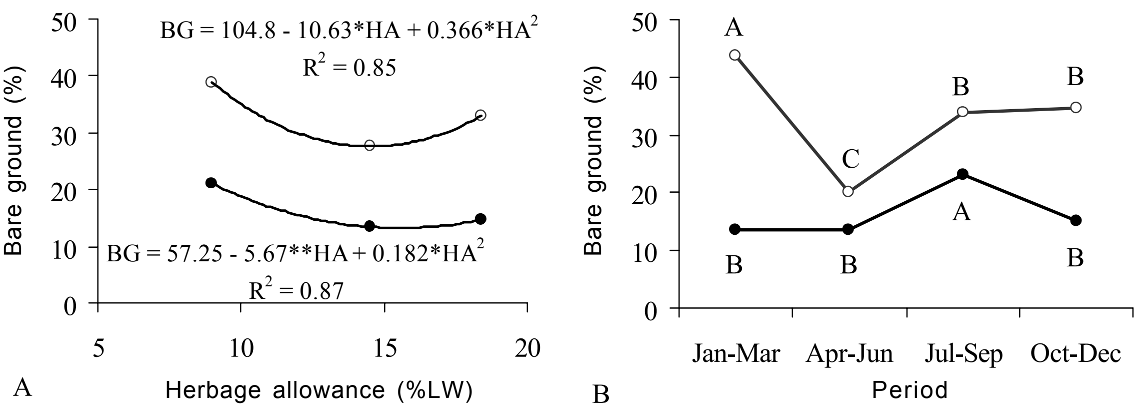

Figure 2 - Variation in pre- (?) and post-grazing (?) percentage of bare ground as a function of herbage allowance (A) and period of the year (B). *, ** Significant by F test at the 5% and 1% level, respectively. Means with the same letters, for each variable, are not different by the Tukey test at the 5% level.

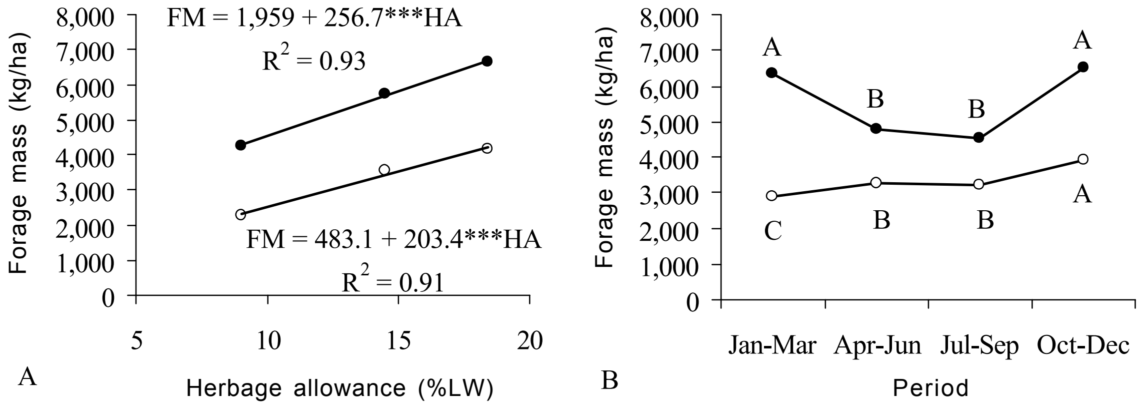

Figure 3 - Variation in pre- (?) and post-grazing (?) forage mass as a function of herbage allowance (A) and period of the year (B). *** Significant by F test at the 0.1% level. Means with the same letters, for each variable, are not different by the Tukey test at the 5% level.

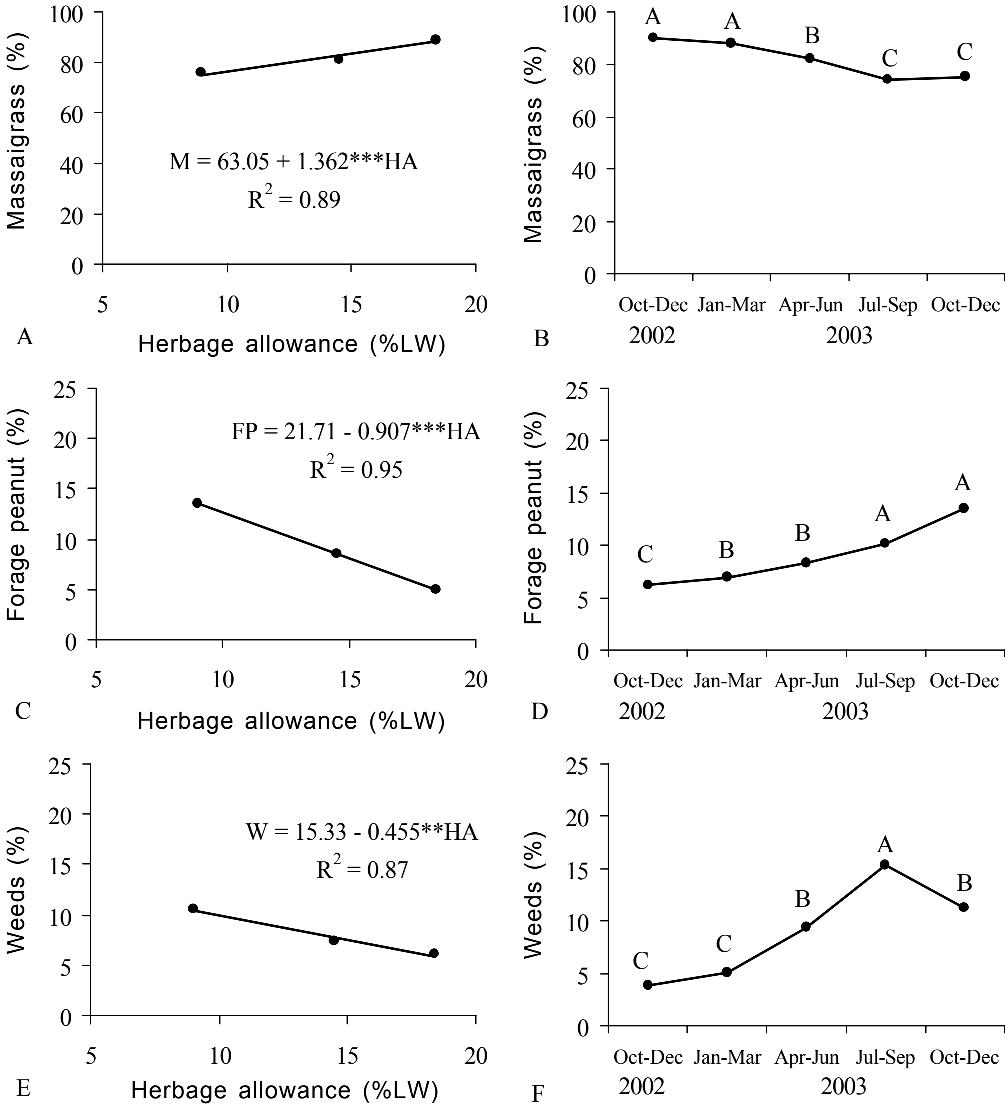

Figure 4 - Variation in pre-grazing percentage of massaigrass, forage peanut and weeds, as a function of herbage allowance (A, C, E) and period of the year (B, D, F). **, *** Significant by F test at the 1% and 0.1% level, respectively. Means with the same letters, for each variable, are not different by the Tukey test at the 5% level.

The characterization of sward height, percentage of bare ground and forage mass demonstrated that the experimental technique was efficient in establishing and maintaining pastures with contrasting though non-static average sward conditions due to considerable seasonal variation, caused primarily by the effect of climate variation on pasture growth rate.

Pasture botanical composition initially included 91% of massaigrass, 5% of forage peanut and 4% of weeds. Over the experimental period, pastures tended to present a lower percentage of massaigrass (Figure 4A) and higher percentages of forage peanut (Figure 4C) and weeds (Figure 4E), as HA levels decreased. The increase in unpalatable weeds is a common phenomenon in intensively grazed pastures (Humphreys, 1991). However, the angular coefficients of the regressions demonstrate a twofold participation of forage peanut in comparison with weeds in reducing the percentage of massaigrass with decreasing HA levels.

The percentage of forage peanut increased progressively over the experimental period (Figure 4D),

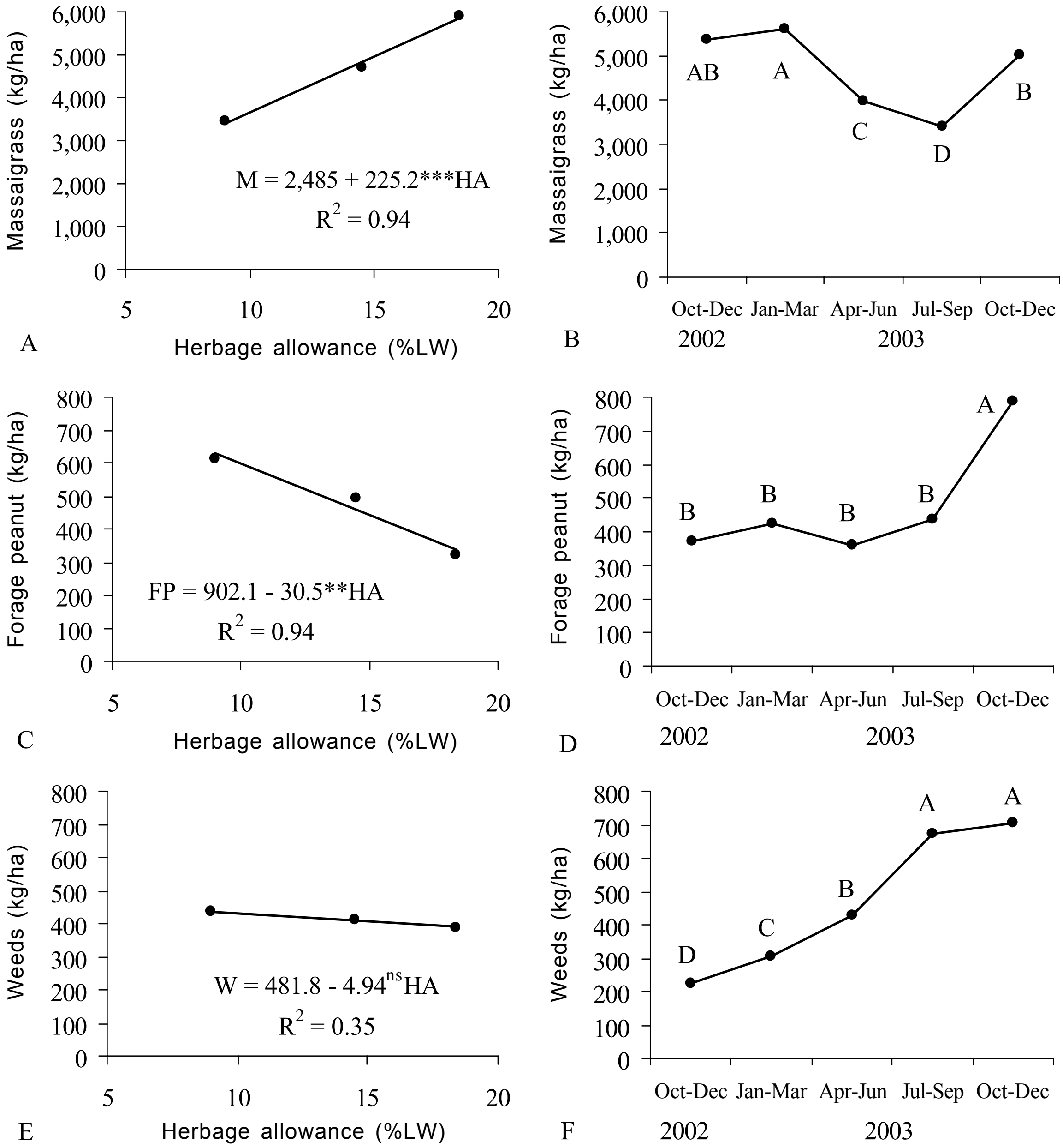

Figure 5 - Variation in pre-grazing forage mass of massaigrass, forage peanut and weeds, as a function of herbage allowance (A, C, E) and period of the year (B, D, F). ^{ns}, **, *** Not-significant by F test at the 5% level, and significant at 1% and 0.1%, respectively. Means with the same letters, for each variable, are not different by the Tukey test at the 5% level.

irrespective of HA level. Only in August 2003 (peak of dry season) there was leaf shedding of *A. pintoi* in response to water stress (Ludlow, 1980), consequently reducing its percentage at all HA levels (data not presented). However, *A. pintoi* recovered its normal growth after showers of rain that occurred at the beginning of September. Percentage of forage peanut varied from 3.4 to 8.4% in Oct/Dec 2002, from the highest to the lowest HA level, respectively, and from 6.4 to 23.5% in the same period of 2003. Similar behavior was observed for Amarillo and Belmonte cultivars of *A. pintoi* when associated with *Brachiaria dyctioneura*, in Colombia (Fisher & Cruz, 1995) and in Brazil (Santana et al., 1998), respectively. In the study conducted by Fisher & Cruz (1995), percentage of forage peanut increased irrespective of HA level and initial botanical composition, reaching between 30 and 50% in the third experimental year.

Massaigrass and weeds demonstrated different behavior. During the early dry season (Apr/Jun), percentage of massaigrass declined in relation to Jan/Mar (Figure 4B), with inverse behavior occurring for percentage of weeds (Figure 4F). Percentage of massaigrass continued to decrease until the end of dry season (Jul/Sep), remaining relatively stable at the onset of the rainy season (Oct/Dec 2003). Percentage of weeds declined after reaching a peak in Jul/Sep (15.4%, on average over the three HA levels), due to higher growth of other pasture components in Oct/Dec 2003, especially forage peanut.

Botanical composition was also analyzed as pre-grazing forage mass of pasture components. Forage mass of massaigrass increased linearly with increasing HA levels (Figure 5A), similarly to its percentage. On average, over the experimental period, forage mass of massaigrass reached values of 3,450, 4,710 and 5,900 kg/ha (DM), from the lowest to the highest HA level, respectively. Massaigrass presented higher forage mass during rainy periods (Figure 5B). Averaged over HA levels, its forage mass declined from 5,610 kg/ha in Jan/Mar to 3,430 kg/ha in Jul/Sep.

Dry matter of weeds was not influenced (P>0.05) by HA levels (Figure 5E), but increased progressively from Oct/Dec 2002 until the end of dry season (Jul/Sep 2003), when it stabilized at approximately 680 kg/ha (Figure 5F). Weeds consisted primarily of native *Paspalum* sp. grasses and a herbaceous broad leaf species commonly known as *língua-de-vaca*. These weeds were already present in the pasture at the beginning of the experiment, and increased their percentages over the experimental period in all treatments, especially in some places disturbed by the grazing animals, such as vicinities of water sources and rest places. The increase of weeds was also observed to be higher in places where forage peanut was absent. In the last quarter of the experimental period, there was a negative correlation between the forage mass of *A. pintoi* and that of weeds (r = - 0.61).

Forage mass of *A. pintoi* increased linearly with decreasing HA levels (Figure 5C). The absence of interaction (P>0.05) between herbage allowance and period of the year for the forage mass of *A. pintoi* indicates that sward structure modification had already influenced forage peanut growth at the first quarter of the experimental period (Oct/Dec 2002), which corresponded to the onset of the rainy season. At the end of the pre-experimental period (September 2002), forage mass of *A. pintoi* was 230 kg/ha, and was maintained relatively stable between 360 and 430 kg/ha, on average over the HA levels, until Jul/Sep 2003 (Figure 5D). *A. pintoi* had very high growth rates in all treatments after the onset of rainy season (Oct/Dec 2003), reaching a forage mass of 1,140, 720 and 510 kg/ha, from the lowest to the highest HA level, respectively. This increase in forage mass resulted not only from the growth of established stolons, but also from new plants that originated from the soil seed bank which germinated vigorously after the first showers of rain in September. Seed banks of *A. pintoi* in mixed pastures have varied from 300-330 kg/ha, when associated with *P. atratum* cv. Pojuca in the Cerrados of Brazil (Barcellos et al., 1999), to 480-570 kg/ha (more than 600 seeds/m^2) when associated with *Brachiaria humidicola* and *B. dyctioneura* in Colombia (Grof, 1985b).

Most studies evaluating the dynamics of botanical composition in mixed pastures with *A. pintoi* have presented only initial-final composition or annual variation. However, understanding seasonal variation in pasture botanical composition is an important step for the development of successful grazing management strategies. In the present study it was demonstrated that the onset of rainy season was the most favorable moment for this legume to increase its population in all HA levels. This can be explained because, in this period, sward structure presented small height and forage mass, and a large percentage of bare ground. The importance of seeds for *A. pintoi* persistence was also confirmed, even under the climatic conditions of Acre. In drier regions, the importance of this source of persistence should be even higher.

The effect of grazing intensity on percentage of *A. pintoi* in mixed pastures is well defined. Studies carried out else where, in association with several grass species (González et al., 1996; Ibrahim & Mannetje, 1998; Santana et al., 1998; Barcellos et al., 1999) have consistently shown a higher percentage of *A. pintoi* under higher grazing intensities, demonstrating its grazing resistance. This can be contrasted with prostrated legumes such as *Desmodium ovalifolium*, whose high grazing resistance can be partially attributed to its low palatability (avoidance mechanism) while *A. pintoi* is a palatable legume (Lascano, 2000). Its prostrate and stoloniferous growth habit, with growing points protected from grazing, impart high grazing resistance to it. Therefore, the increase of *A. pintoi* percentage and forage mass under higher grazing intensities was not related to grazing selectivity, but primarily to sward structure modification.

In lightly grazed pastures, presenting high sward height and forage mass (high leaf area index), forage peanut has lower growth rate due to high shading levels. Although *A. pintoi* presents high tolerance to shading (Fisher & Cruz, 1995; Andrade et al., 2004), its prostrate growth habit hinders access to light when associated with tall grasses like massaigrass, except under higher grazing intensities, when the grass presents smaller height and more spaces exist among its tussocks, favoring light penetration. However, even in the taller sward (HA of 18.4% LW), *A. pintoi* persisted and increased its percentage and forage mass over the experimental period. This was possible because of the high phenotypic plasticity of *A. pintoi*, which enables it to exploit efficiently the spatial heterogeneity of the pasture. In patches with dense and tall tussocks of massaigrass, stolons of forage peanut presented erect growth, reaching a height of up to 65 cm. In some places, these stolons grew even inside the dense tussocks of massaigrass, utilizing this additional support to access more illuminated layers of the sward. At the end of rest periods, in some places, it was only possible to visualize *A. pintoi* plants by looking downwards after moving grass leaves out of the way. This means that forage peanut grew under the shade of massaigrass foliage during part of the rest period.

The legume quickly increased in percentage in places where the grazing animals lied down on the tussocks of massaigrass altering the vertical structure of the sward. Similar behavior was observed in a mixed *A. pintoi* and *B. ruziziensis* pasture, in Colombia, where the legume quickly colonized the spaces opened in the sward after a severe spittlebug attack (Grof, 1985b). This is similar to the so-called “guerilla habit” of exploiting gaps or discontinuous areas of grass growth, presented by white clover plants (Hay & Hunt, 1989). Clone-forming species, such as white clover and forage peanut, possess great competition potential, because the plant can guide the distribution of its biomass to better exploit the heterogeneity of resources such as water, light and nutrients from different patches that contain clones (Forde et al., 1989; Lemaire, 2001). However, although forage peanut presents good mobility at short distances, its capacity for colonizing new pasture areas at long distances is limited, mainly because of its geocarpic (underground) seed production (Ferguson, 1995). Thus, seed burial of *A. pintoi* is a persistence mechanism rather than a dissemination mechanism. Its principal mechanism for colonisation of new areas rests on its vegetative propagation through emission of stolons.

Although the present experiment took place over just 22 months, forage peanut persistence in this mixed pasture reached nine years, after its establishment in 1994. This persistence capacity becomes even more important when considering the several management conditions to which this pasture was subjected, from grazing by calves under continuous stocking to remaining ungrazed over long periods. Persistence of *A. pintoi* cv. Belmonte under grazing over more than 10 years, when associated with *B. humidicola* in the coastal region of Bahia, Brazil is reported by Pereira (2002).

Conclusions

Arachis pintoi can be successfully associated with massaigrass and managed under intermittent stocking in the environmental conditions of the Western Brazilian Amazon; however, to maintain a desirable content of the legume in the mixture, pre-grazing sward height should be maintained no higher than 65-70 cm, in order to prevent excessive shading to the legume.

Literature Cited

ANDRADE, C.M.S.; VALENTIM, J.F.; CARNEIRO, J.C. et al. Crescimento de gramíneas e leguminosas forrageiras tropicais sob sombreamento. **Pesquisa Agropecuária Brasileira**, v.39, n.3, p.263-270, 2004.

BARCELLOS, A.O.; ANDRADE, R.P.; KARIA, C.T. et al. Potencial e uso de leguminosas forrageiras dos gêneros *Stylosanthes*, *Arachis* e *Leucaena*. In: SIMPÓSIO SOBRE MANEJO DA PASTAGEM, 17., 2001, Piracicaba. **Anais...** Piracicaba: Fundação de Estudos Agrários Luiz de Queiroz, 2001. 2.ed. p.365-425.

BARCELLOS, A.O.; PIZARRO, E.A.; COSTA, N.L. Agronomic evaluation of novel germoplasm under grazing: *Arachis pintoi* BRA-031143 and *Paspalum atratum* BRA-009610. In: INTERNATIONAL GRASSLAND CONGRESS, 18., 1997, Winnipeg. **Proceedings...** Saskatoon: CFC/CSA/CSAS, 1999. 1 CD-ROM

BARCELLOS, A.O.; VILELA, L. Leguminosas forrageiras tropicais: estado de arte e perspectivas futuras. In: SIMPÓSIO INTERNACIONAL DE FORRAGICULTURA, 1994, Maringá. **Anais...** Maringá: Editora da Universidade Estadual de Maringá, 1994. p.1-56.

BRÂNCIO, P.A. **Comportamento animal e estimativas de consumo por bovinos em pastagens de *Panicum maximum***

Jacq. (cultivares Tanzânia, Mombaça e Massai). Viçosa: UFV, 2000. 278p. Tese (Doutorado em Zootecnia) – Universidade Federal de Viçosa, 2000.

CARADUS, J.R.; HARRIS, S.L.; JOHNSON, R.J. Increased clover content for increased milk production. In: RUAKURA FARMERS' CONFERENCE, 48., 1996, Hamilton. **Proceedings...** Hamilton: Dairying Research Corporation, 1996. p.42-49.

ELBASHA, E.; THORNTON, P.K.; TARAWALI, G. **An ex post economic impact assessment of planted forages in West Africa**. Nairobi: International Livestock Research Institute, 1999. 61p. (ILRI Impact Assessment Series, 2).

FERGUSON, J.E. Biología de la semilla y sistemas de producción de semilla para *Arachis pintoi*. In: KERRIDGE, P.C. (Ed.) **Biología y agronomia de especies forrajeras de *Arachis***. Cali: CIAT, 1995. p.131-143.

FISHER, M.J.; CRUZ., P. Algunos aspectos de la ecofisiología de *Arachis pintoi*. In: KERRIDGE, P.C. (Ed.) **Biología y agronomia de especies forrajeras de *Arachis***. Cali: CIAT, 1995. p.56-75.

FORDE, M.B.; HAY, M.J.M.; BROCK, J.L. Development and growth characteristics of temperate perennial legumes. In: MARTEN, G.C.; MATCHES, A.G.; BARNES, R.F. et al. (Ed.) **Persistence of forage legumes**. Madison: ASA/CSSA/SSSA, 1989. p.91-108.

GONZÁLEZ, M.S.; VAN HEURCK, L.M.; ROMERO, F. et al. Producción de leche en pasturas de estrella africana (*Cynodon nlemfuensis*) solo y asociado con *Arachis pintoi* o *Desmodium ovalifolium*. **Pasturas Tropicales**, v.18, n.1, p.2-12, 1996.

GROF, B. *Arachis pintoi*, una leguminosa forrajera promisoria para los Llanos Orientales de Colombia. **Pastos Tropicales**, v.7, p.4-5, 1985a.

GROF, B. Forage attributes of the perennial groundnut *Arachis pintoi* in a tropical savanna environment in Colombia. In: INTERNATIONAL GRASSLAND CONGRESS, 15., 1985, Kyoto. **Proceedings...** Nishi-Nasuno: Japanese Society of Grassland Science, 1985b. p.168-170.

HAY, R.J.M.; HUNT, W.F. Competition from associated species on white and red clover in grazed swards. In: MARTEN, G.C.; MATCHES, A.G.; BARNES, R.F. et al. (Eds.) **Persistence of Forage Legumes**. Madison: ASA/CSSA/SSSA, 1989. p.311-325.

HOVELAND, C.S. Problems in establishment and maintenance of mixed swards. In: INTERNATIONAL GRASSLANDS CONGRESS, 18., 1997, Winnipeg. **Proceedings...** Winnipeg: CFC/CSA/CSAS, 1999. p.411-416.

HUMPHREYS, L.R. **Tropical pasture utilization**. Cambridge: Cambridge University Press, 1991. 206p.

IBRAHIM, M.A.; MANNETJE, L.'t. Compatibility, persistence and productivity of grass-legume mixtures in the humid tropics of Costa Rica. 1. Dry matter yield, nitrogen yield and botanical composition. **Tropical Grasslands**, v.32, n.2, p.96-104, 1998.

JONES, R.M. Persistency of *Arachis pintoi* cv. Amarillo on three soil types at Samford, south-eastern Queensland. **Tropical Grasslands**, v.27, p.11-15, 1993.

LAIDLAW, A.S.; TEUBER, N. Temperate forage grass-legume mixtures: advances and perspectives. In: INTERNATIONAL GRASSLAND CONGRESS, 19., 2001, São Pedro. **Proceedings**... São Paulo: SBZ, 2001. 1 CD-ROM

LASCANO, C.E. Selective grazing on grass-legume mixtures in tropical pastures. In: LEMAIRE, G.; HODGSON, J.; MORAES, A. et al. (Eds.) **Grassland ecophysiology and grazing ecology**. Wallingford: CAB International, 2000. p.249-263.

LEMAIRE, G. Ecophysiology of grasslands: dynamic aspects of forage plant populations in grazed swards. In: INTERNATIONAL GRASSLAND CONGRESS, 19., 2001, São Pedro. **Proceedings...** São Paulo: SBZ, 2001. 1 CD-ROM.

LEMPP, B.; SOUZA, F.H.D.; COSTA, J.C.G. et al. **Capim-massai (*Panicum maximum* cv. Massai)**: alternativa para diversificação de pastagens. Campo Grande: Embrapa Gado de Corte, 2001. 9p. (Comunicado Técnico, 69).

LUDLOW, M.M. Stress physiology of tropical pasture plants. **Tropical Grasslands**, v.14, n.3, p.136-145, 1980.

MANNETJE, L.'t. Harry Stobbs Memorial Lecture 1994: Potential and prospects of legume based pastures in the tropics. **Tropical Grasslands**, v.31, p.81-94, 1997.

NASCIMENTO, M.P.S.C.B.; NASCIMENTO, H.T.S.; ARAÚJO NETO, R.B. et al. **O capim-massai no Meio-Norte**. Teresina: Embrapa Meio Norte, 2002. 3p. (Comunicado Técnico, 144).

PEREIRA, J.M. Leguminosas forrageiras em sistemas de produção de ruminantes: onde estamos? para onde vamos? In: SIMPÓSIO SOBRE MANEJO ESTRATÉGICO DE PASTAGENS, 1., 2002, Viçosa, MG. **Anais...** Viçosa, MG: Universidade Federal de Viçosa, 2002. p.109-147.

PÉREZ, R.A.; LASCANO, C.E. Potencial de producción animal de asociaciones de gramíneas y leguminosas promisorias en el piedemonte de la Orinoquia Colombiana. In: RED INTERNACIONAL DE EVALUACIÓN DE PASTOS TROPICALES – Sabanas, 1., 1992, Brasília. **Anais...** Cali: CIAT, 1992. p.585-593.

PERIN, R. **Características da pastagem e desempenho animal em uma consorciação de *Panicum maximum* Jacq cv. Tanzânia e *Arachis pintoi* submetida a diferentes alturas de manejo**. Curitiba: Universidade Federal do Paraná, 2003. 102p. Tese (Doutorado em Agronomia) – Universidade Federal do Paraná, 2003.

SANTANA, J.R.; PEREIRA, J.M.; RESENDE, C.P. Avaliação da consorciação de *Brachiaria dictyoneura* Stapf com *Arachis pintoi* Krapov & Gregory sob pastejo. In: REUNIÃO ANUAL DA SOCIEDADE BRASILEIRA DE ZOOTECNIA, 35., 1998, Botucatu. **Anais...** Botucatu: SBZ, 1998. 1 CD-ROM

SPAIN, J.M. O uso de leguminosas herbáceas nas pastagens tropicais. In: PEIXOTO, A.M.; MOURA, J.C.; FARIA, V.P. (Eds.) **Plantas forrageiras de pastagens**. Piracicaba: Fundação de Estudos Agrários Luiz de Queiroz, 1995. p.275-299.

THOMAS, R.J. Roles of legumes in providing N for sustainable tropical pasture systems. **Plant and Soil**, v.174, n.1-2, p.103-118, 1995.

VALENTIM, J.F.; ANDRADE, C.M.S. Perspectives of grass-legume pastures for sustainable animal production in the tropics. In: REUNIÃO ANNUAL DA SOCIEDADE BRASILEIRA DE ZOOTECNIA, 40., 2004, Campo Grande. **Anais...** Campo Grande: Sociedade Brasileira de Zootecnia, 2004. p.142-154.

VALENTIM, J.F.; CARNEIRO, J.C.; MOREIRA, P. et al. **Capim-massai (*Panicum maximum* Jacq.)**: nova forrageira para a diversificação das pastagens no Acre. Rio Branco: Embrapa Acre, 2001a. 16p. (Circular Técnica, 41).

VALENTIM, J.F.; CARNEIRO, J.C.; SALES, M.F.L. **Amendoim forrageiro cv. Belmonte**: leguminosa para a diversificação das pastagens e conservação do solo no Acre. Rio Branco: Embrapa Acre, 2001b. 18p. (Circular Técnica, 43).

VALENTIM, J.F.; MOREIRA, P. **Adaptação, produtividade, composição morfológica e distribuição estacional da produção de forragem de ecotipos de *Panicum maximum* no Acre**. Rio Branco: EMBRAPA-CPAF-Acre, 1994. 24p. (Boletim de Pesquisa, 11).

WHALLEY, R.D.B.; HARDY, M.B. Measuring botanical composition of grasslands. In: MANNETJE, L.'t; JONES, R.M. (Ed.) **Field and laboratory methods for grassland and animal production research**. Wallingford: CAB International, 2000. p.67-102.

Recebido: 20/09/04
Aprovado: 17/10/05