



Tropentag 2016, Vienna, Austria  
September 18-21, 2016

Conference on International Research on Food Security, Natural Resource  
Management and Rural Development  
organised by the University of Natural Resources and Life Sciences  
(BOKU Vienna), Austria

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### Sustainable beef production with forage associations in the American tropics

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Grass-legume forage associations are an alternative to address seasonality in feed supply in livestock systems, as they provide benefits in the production of biomass as well as in terms of diet quality and productivity. At the same time, they contribute to achieving sustainability of livestock production in the American tropics and thus play an important role in addressing national sustainability plans and strategies such as the Colombian Strategic Plan for Livestock Production (PEGA 2019) aiming at a reduction of the total area under pasture.

Under a completely randomized block design, three treatments with three repetitions were sown and evaluated for daily animal live weight gains in 2015: 1) the grass *Brachiaria brizantha* cv. Toledo as monoculture, 2) *Brachiaria brizantha* cv. Toledo associated with the legume *Canavalia brasiliensis*, and 3) *Brachiaria brizantha* cv. Toledo associated with *Canavalia brasiliensis* and *Leucaena diversifolia*. This resulted in a trial with a total of 9 experimental plots on 3.0 hectares. Once established, rotational grazing started with 15 commercial animals (male Zebu, five animals per treatment, initial live weight of 200 kg) and data was obtained for measuring daily live weight gains in relation to each treatment.

Results demonstrate that the animals with highest individual weight gains were the ones grazing *Brachiaria brizantha* cv. Toledo associated with the legume *Canavalia brasiliensis*, showing daily gains of 380 grams – 125 grams more than those grazing *Brachiaria brizantha* cv. Toledo only. With regard to overall productivity of each treatment, animals grazing grass-legume associations (*Brachiaria brizantha* cv. Toledo + *Canavalia brasiliensis*; *Brachiaria brizantha* cv. Toledo + *Canavalia brasiliensis* + *Leucaena diversifolia*) showed higher per area live weight gains (554 and 526 kg/year) than those grazing *Brachiaria brizantha* cv. Toledo only (371 kg/year). The higher per area productivity of grass-legume associations is related to both forage quantity and quality. The results show that associations could be a valuable option for livestock producers in the tropics, for achieving higher productivity levels but also for sustainable intensification of livestock production systems and thus can contribute to compliance with national sustainability plans and strategies.

**Key words:** Forage associations, live weight gain, tropical beef production, tropical forages, sustainable intensification.

## Introduction

Cattle farming is an activity of high global relevance, since it occupies 4.9 billion hectares, and with 17 billion bovine heads, represents a total economic value of US\$ 1.4 trillion (FAO, 2013). The relevance of the sector in Colombia is similar, given that cattle farming is the most representative agricultural activity contributing with 53% to the livestock Gross Domestic Product (GDP), 19.5% to the total agricultural GDP and to 1.3% of the national GDP (Fedegan-FNG, 2014). Currently, 34.9 million hectares (32% of the national territory) are used as pastures for 23.5 million animals, resulting in an average stocking rate of 0.67 AU/ha. This indicator reflects the low efficiency and productivity of the systems. Livestock production is also responsible for 14.5% of the anthropogenic greenhouse gas emissions (GHG), and only by implementing more efficient production practices, the emissions could be effectively reduced. That is where technological alternatives, such as grass-legume forage associations become relevant, since they improve the animal diet both in terms of quantity and quality, allowing to advance towards a more sustainable and eco-efficient production system. These technologies also address critical issues in the livestock production system, such as high seasonality of feed supply, nutritional quality and tolerance to biotic and abiotic stresses, which would allow to reduce the area under grazing according to the Colombian Strategic Plan for Livestock Production (PEGA 2019) (Fedegan, 2006).

Following this plan, nearly 10 million hectares are expected to be released from cattle production and redirected towards agriculture and forestry projects (Fedegan, 2006). To achieve that, it is necessary to transform the cattle production systems making use of improved forages and forage-based production systems. The plan also contemplates the establishment of more eco-friendly production systems such as silvopastoral systems, which provide several benefits for the different components within it (soil, plants, and animals) and various positive effects for the environment.

The objective of this study was to measure animal live weight gains in grass-legume associations with the aim to analyze the forage effect on the animal, expressed in productivity per unit area, as well as the persistence of legumes under grazing. By this we aim to evaluate the potential of grass-legume forage associations for sustainable intensification of livestock production systems in the American tropics.

## Materials and Methods

The trials took place at CIAT headquarters in Palmira, Valle del Cauca, Colombia under coordinates 3°30'7"N and 76°21'22"W (altitude: 990 m.a.s.l., yearly precipitation: 1.800 mm, mean temperature: 24°C). It is currently characterized and evaluated on soil classified as Mollisoles.

Under a completely randomized block design, three treatments with three repetitions were sown and evaluated for daily animal live weight gains in 2015: (T1) the grass *Brachiaria brizantha* cv. Toledo as monoculture, (T2) *Brachiaria brizantha* cv. Toledo associated with the legume *Canavalia brasiliensis*, and (T3) *Brachiaria brizantha* cv. Toledo associated with *Canavalia brasiliensis* and *Leucaena diversifolia*.

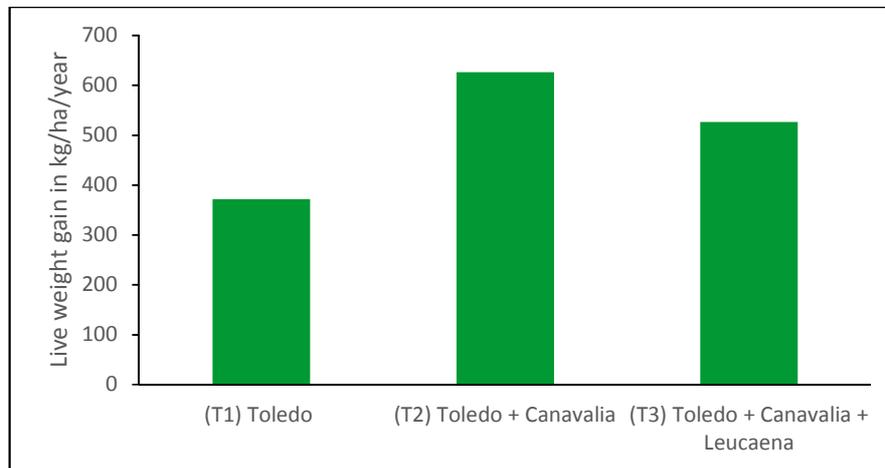
This resulted in a trial with a total of 9 experimental plots on 3 hectares. Once established, rotational grazing started with 15 commercial animals (male Zebu, 5 per treatment, initial

live weight of 200 kg) and data was obtained for measuring daily live weight gains in relation to each treatment. Prior entering the animals in each plot, the total forage supply was quantified in order to estimate the total feed supply and adjust the grazing periods and stocking rate. According to these results, the average occupation period applied in this trial was 21 days and the average resting period 56 days.

## Results and Discussion

Highest animal live weight gains were obtained by the animals grazing *B. brizantha* cv. Toledo + *C. brasiliensis* (T2) reaching 380 g/d - over 125 g more than the animals consuming *B. brizantha* cv. Toledo as monoculture (T1). In terms of per area productivity, animals grazing grass-legume associations (T2 and T3) presented higher per hectare live weight gains than the ones grazing *B. brizantha* cv. Toledo as monoculture (T1): 554 (T2) and 526 (T3) kg/ha/year versus 371 kg/ha/year (T1) (Figure 1). The better performance of associations might be a result of the higher feed availability in both quantity and quality.

**Figure 1.** Productivity, live weight gain (kg/year)



Our results are similar to those obtained by Gaviria et al. (2012), who found out that animals grazing in silvopastoral systems with improved forage associations (*Megathyrsus maximus* and *Cynodon plectostachyus*), reached 1.8 to 2.4 times the production level normally obtained with improved forages monocultures. In terms of per area productivity, they also describe similar results for improved forages as monoculture (341.6 kg/ha/year), and so do Cuadrado et al. (2004) (359 kg/ha/year for *B. brizantha* cv. Toledo as monoculture). For intensive silvopastoral systems (applying *Leucaena leucocephala*) however, Gaviria et al. (2012) evidence superior per area productivity (609-827 kg/ha/year) to our T2 and T3 trials. According to Peters et al. (2011) *B. brizantha* cv. Toledo can produce between 540 and 840 kg meat per hectare and year, applying a stocking rate of up to 3 animals per hectare, depending if it is employed alone or in association of tropical legumes. The material's productivity potential is reported similar to the one describe in our T2 trial (554 kg/ha/year). Also Lascano et al. (2002) report similar results for animals grazing *Brachiaria brizantha* cv. Toledo as monoculture and associations with *Pueraria phaseoloides*, obtaining an animal productivity of 184.3 kg/ha/year for the monoculture, respectively 405.5 kg/ha/year for the association. Our

results, especially when compared to previous studies, reflect the positive effects of grass-legume forage associations on animal productivity.

## Conclusions

Grass-legume forage associations can be a valuable option for livestock producers in the American tropics for achieving higher productivity levels and for increasing resilience to changing environmental conditions. By applying such associations, livestock producers can contribute to a sustainable intensification of livestock production systems by producing more meat per unit area. This in turn can set free area that might be used for reforestation or other agricultural purposes. By this, grass-legume forage associations can contribute strongly to the compliance with national sustainability plans and strategies such as the Colombian Strategic Plan for Livestock Production (PEGA 2019).

## Acknowledgements

This work was done as part of the CGIAR Research Program on Livestock and Fish and as part of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), which is a strategic partnership of CGIAR and Future Earth. We thank all donors that globally support our work through their contributions to the CGIAR system.

## References

- CUADRADO, H., TORREGROZA, L., & JIMENEZ, N. (2004). De cuatro especies de gramíneas del género *Brachiaria* comparación under grazing condition of four species of genus *Brachiaria*. *MVZ-Córdoba* 2004; 9:(2), 439-444.
- FAO (2013). Tackling Climate through Livestock: A Global Assessment of Emissions and Mitigation Opportunities. A Global Assessment of Emissions and Mitigation Opportunities. FAO, Rome.
- FEDEGAN (2006). Plan estratégico de la ganadería colombiana 2019 - Por una ganadería moderna y solidaria. *PEGA2019, Fedegan*, 1, 296. <https://doi.org/978-958-98018-1-9>
- FEDEGAN-FNG (2014). *Plan De Desarrollo Ganadero 2014 - 2019*. <https://doi.org/10.1017/CBO9781107415324.004>
- GAVIRIA, X., SOSSA, C., MONTOYA, C., CHARA, J., LOPERA, J., CORDOBA, C., & BARAHONNA, R. (2012). Producción de Carne Bovina en Sistemas Silvopastoriles Intensivos en el Trópico Bajo Colombiano. Conference Paper. VII Congreso Latinoamericano de Agroforestería para la Producción Animal Sostenible, At Belem, Brasil.
- LASCANO, C., PLAZAS, C., & PEREZ, O. (2002). Pasto Toledo (*Brachiaria brizantha* CIAT 26110) Gramínea de crecimiento vigoroso para intensificar la ganadería colombiana. Corporación Colombiana de Investigación Agropecuaria (CORPOICA); Cali, CO: Centro Internacional de Agricultura Tropical (CIAT), Villavicencio, CO. 18 p.
- PETERS, M., FRANCO, L. H., SCHMIDT, A., & HINCAPIE, B. (2011). Especies forrajeras Multipropósito: Opciones para productores del trópico Americano. Publicación CIAT no. 374. Centro Internacional de Agricultura Tropical (CIAT); Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (BMZ); Deutsche Gesellschaft für Technische Zusammenarbeit (GIZ) (Cali, CO). 212 p.