

Use of *Leucaena* in sustainable livestock systems in the tropics: Evaluation of agronomy, productivity, GHG and soil parameters



Workshop on *Leucaena* breeding and development

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International Center for Tropical Agriculture

Tropical Forages Program

Perth, December 13th, 2017

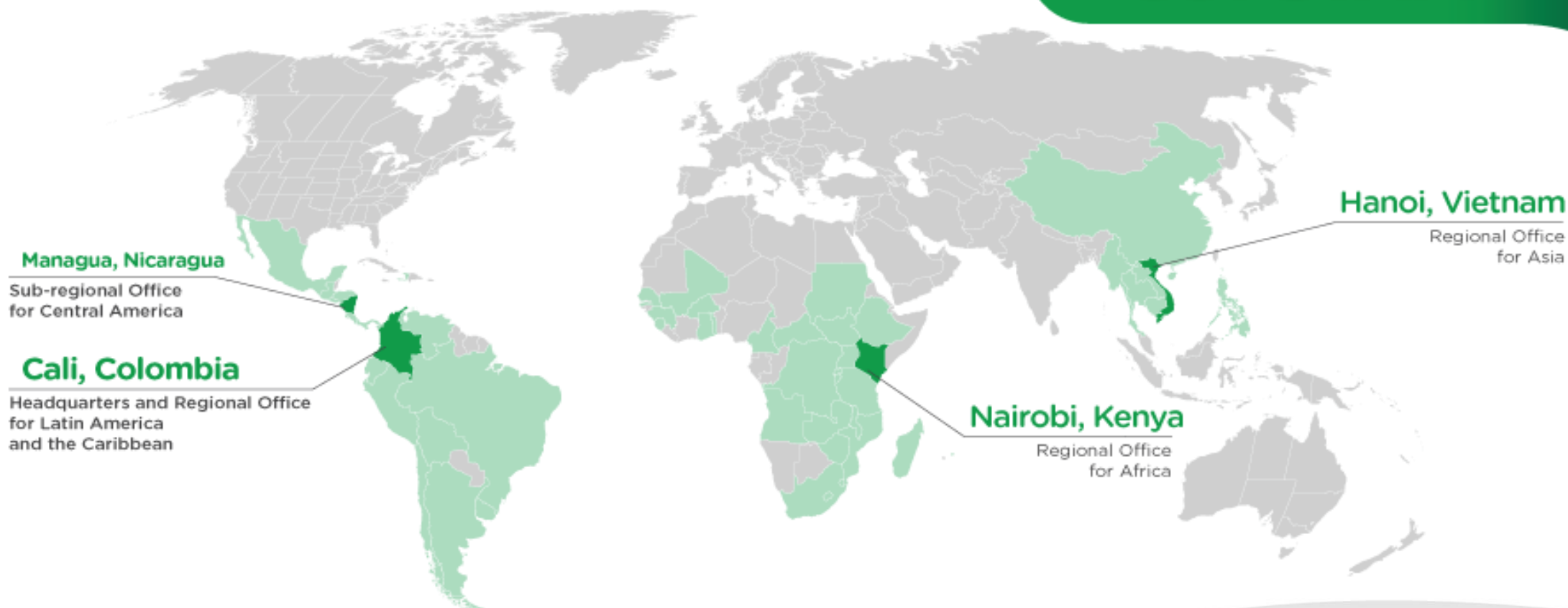


CIAT AROUND THE WORLD

We work in 53 countries* and have 21 offices and field operation sites around the world

*In many of these countries,
we work through PABRA in Africa and FLAR in Latin America

991 STAFF



Our vision, a sustainable food future

Our mission

To reduce hunger and poverty, and improve human nutrition in the tropics through research aimed at increasing the eco-efficiency of agriculture



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CIAT Research areas

AgBio



Agrobiodiversity research in four main crops:

- Bean
- Cassava
- Rice
- Tropical forages

SoiLS



Soils and landscapes for sustainability (SoiLS)

DAPA



Decision and Policy Analysis Area (DAPA): Climate change, linking farmers to markets, impact assessment and ecosystem services.

Preserving the world's largest collections of beans, cassava and tropical forages



37,987

BEAN
ACCESSIONS



6,643

CASSAVA
ACCESSIONS



23,140

TROPICAL
FORAGE
ACCESSIONS

Agrobiodiversity is key to maintaining ecosystems and providing adequate supplies of healthy and nutritious food in the face of climate change and environmental degradation.



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Supporting breeding tropical forage grasses

Developing hybrids of the most widely used tropical forage grasses for differentiated production (> 150 million ha planted):

Co-funding



Urochloa (syn. Brachiaria) spp.



Megathyrsus maximus (syn. Panicum maximum)



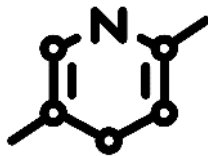
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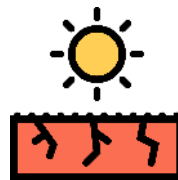
Yield



Quality



Biological Nitrification
Inhibition



Stress tolerance

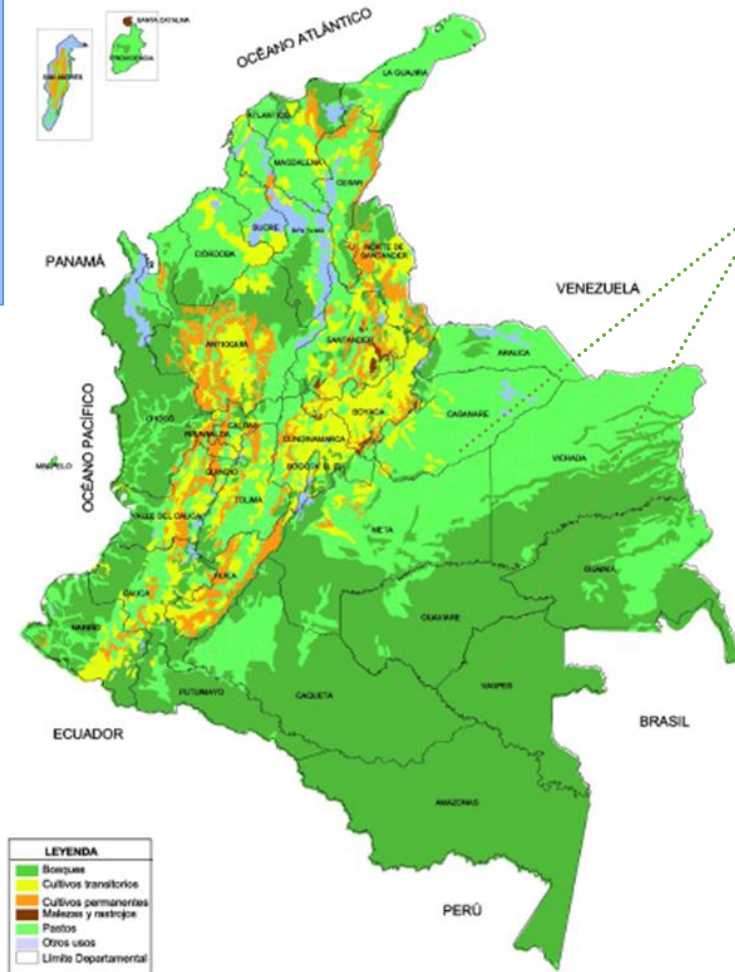


Seed production

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Livestock in Colombia



- 58.6 Mha in forest (51% territory)
- 34.9 Mha in grassland (32% territory)
Little % in improved forages
- 7% of the national labor market
- 1.3% of the GDP (Gross domestic product)
- 400,000 smallholder families
- 23.5 millions of animals (0.7 AU/ha)

Sources: IGAC 2012, IDEAM 2014, FEDEGÁN-FNG 2014

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Agronomic evaluation of 23 accessions of *Leucaena diversifolia*

Seed Genetic Bank – CIAT

Experimental design: randomized complete blocks, using each accession as a treatment, with five plants per treatment planted at a distance of one meter between plants, and meter and a half between treatment and two meters between blocks

Production evaluation:

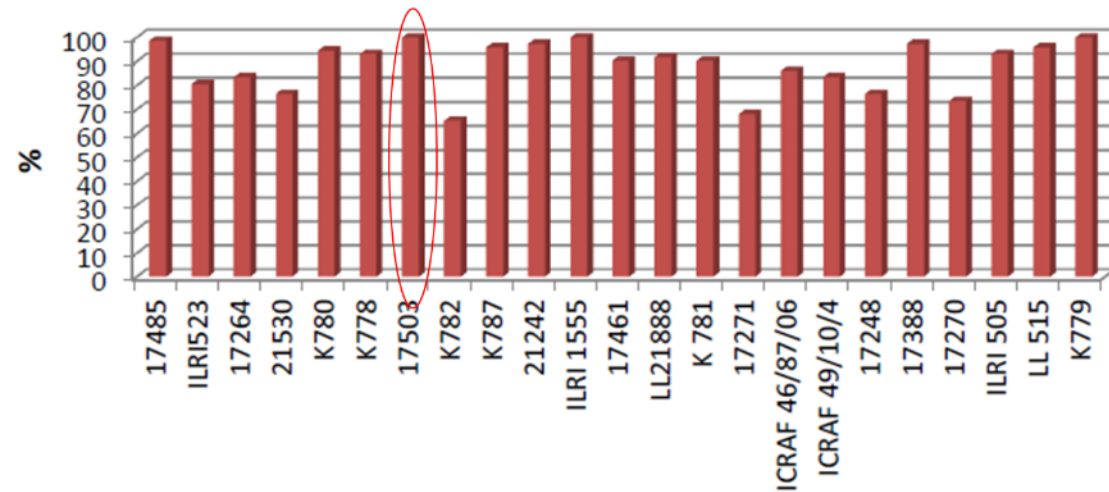
Each 8 weeks – Two periods (Max – Min rainfall)

- Germination
- Height and diameter of the plant.
- Number of regrowths
- Biomass production
- Plagues and diseases.
- Nutritional characterization: DM, CP, NDF, ADF, IVDMD
(wet chemistry and NIRS)

	Santa Ana	El Tablón
pH (Un)	6,145	5,49
MO (g/kg)	146,8745	48,9261
P-Brayll (mg/kg)	5,789	0,429
K (cmol/kg)	0,4293	0,2391
Ca (cmol/kg)	3,2137	1,35
Mg (cmol/kg)	0,7645	0,608
Al (cmol/kg)	-----	-----
Na (cmol/kg)	0,0178	0,1134
ClC (cmol/kg)	42,6	22,6
S (mg/kg)	69,808	76,839
B (mg/kg)	0,737	0,285
Fe (mg/kg)	3,3306	5,7436
Mn (mg/kg)	7,2962	36,8126
Cu (mg/kg)	0,0313	0,7443
Zn (mg/kg)	0,7987	0,6183

Agronomic evaluation

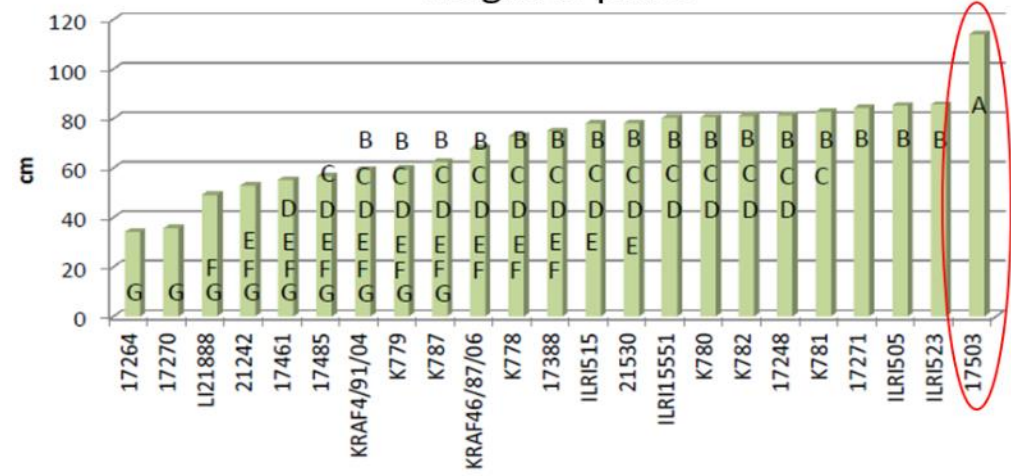
Germination 30 days after sowing



Seeds treated with 80% sulfuric acid

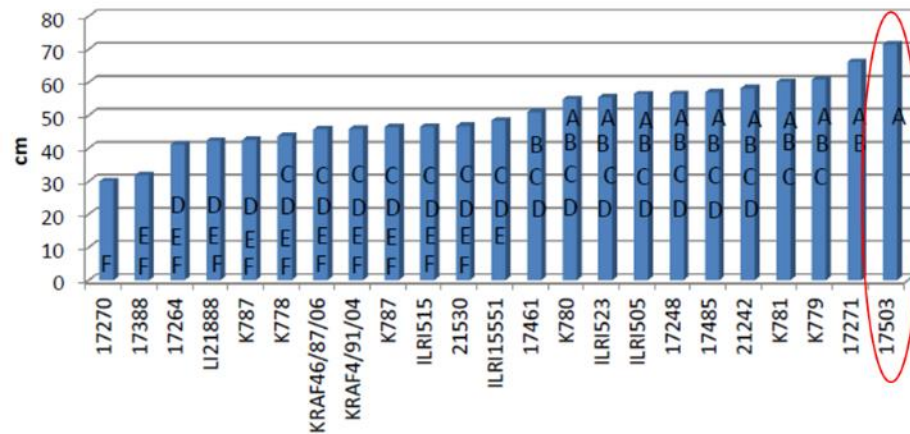
Accession

Height of plant



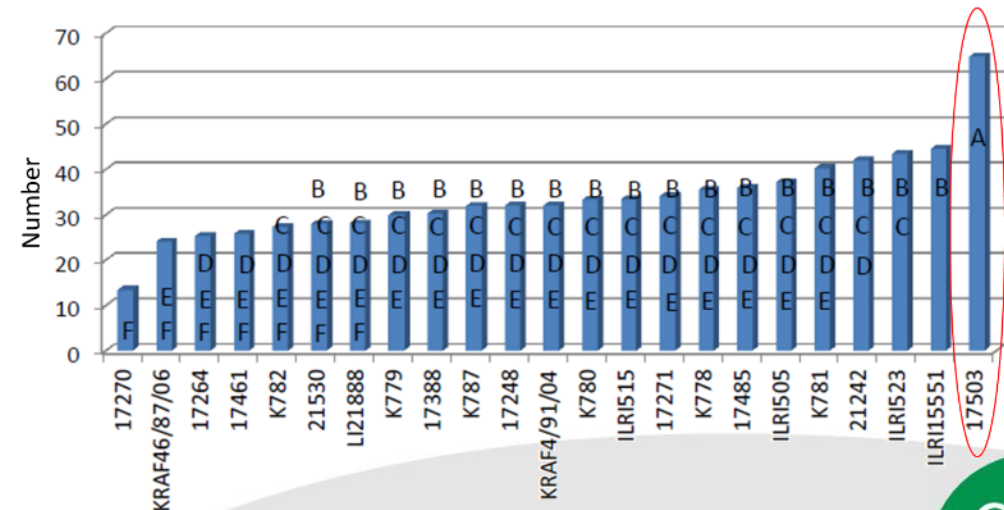
Accession

Plant diameter



Accession

Number of Regrowths

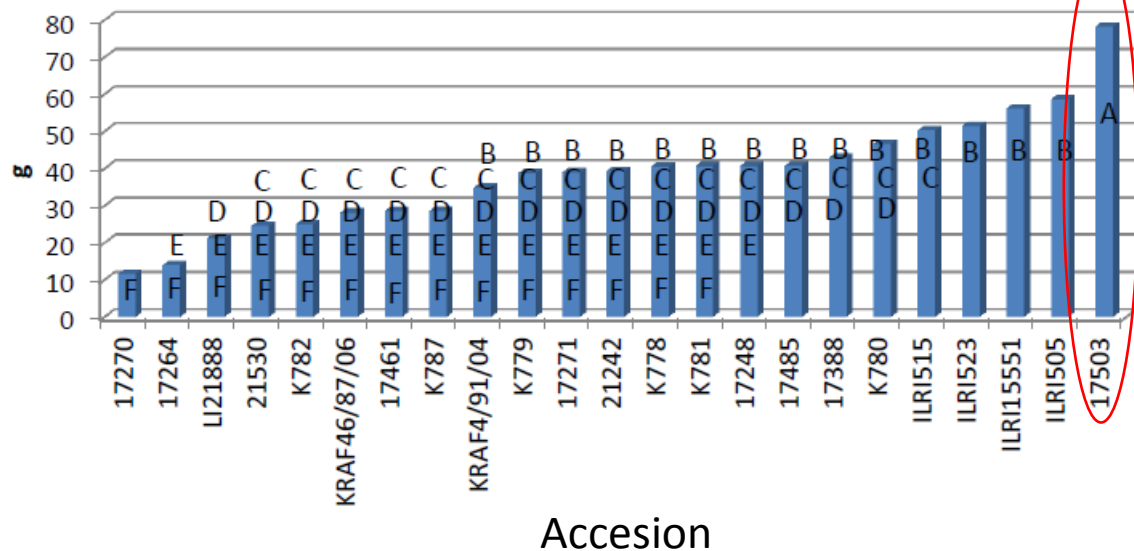


Accession

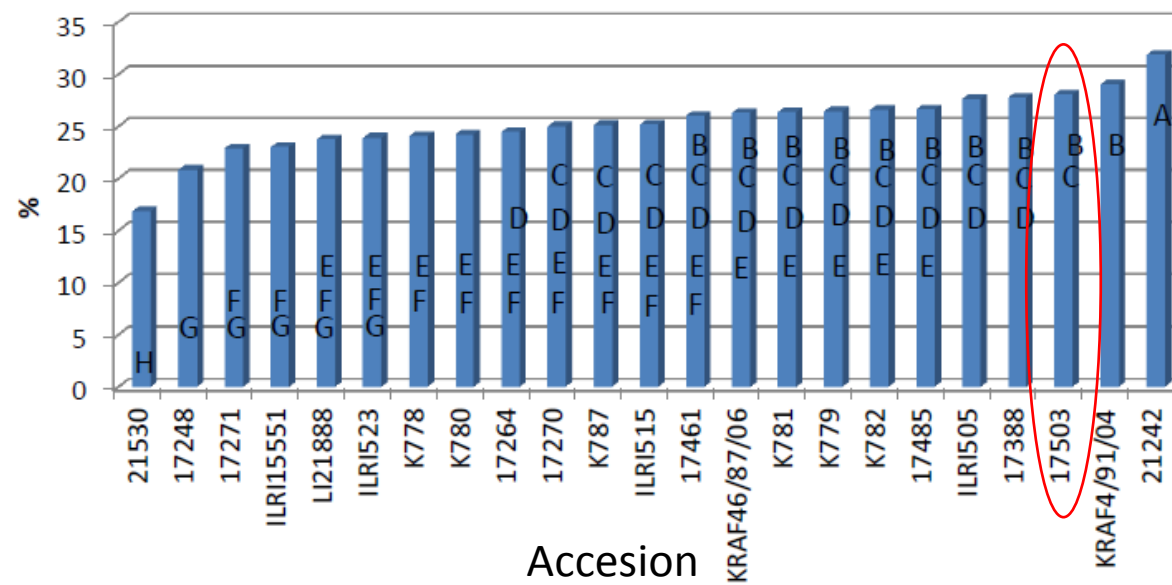
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Biomass production

FORAGE PRODUCTION/PLANT

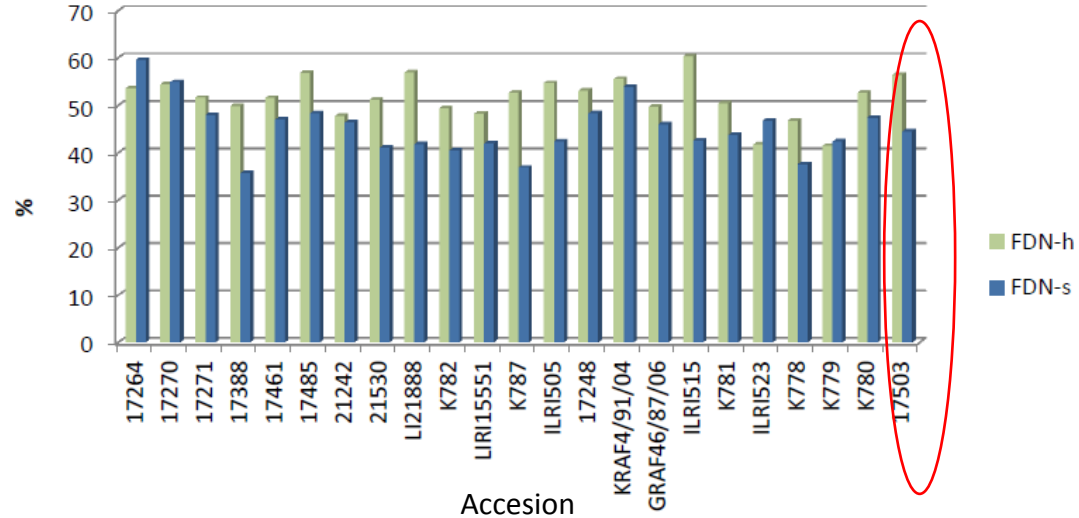


DRY MATTER

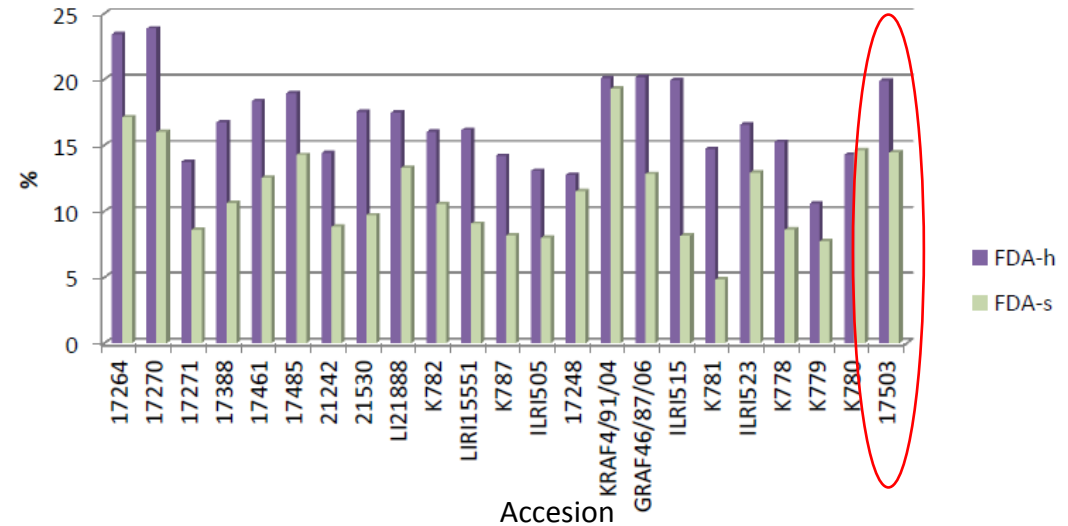


Nutritional characterization

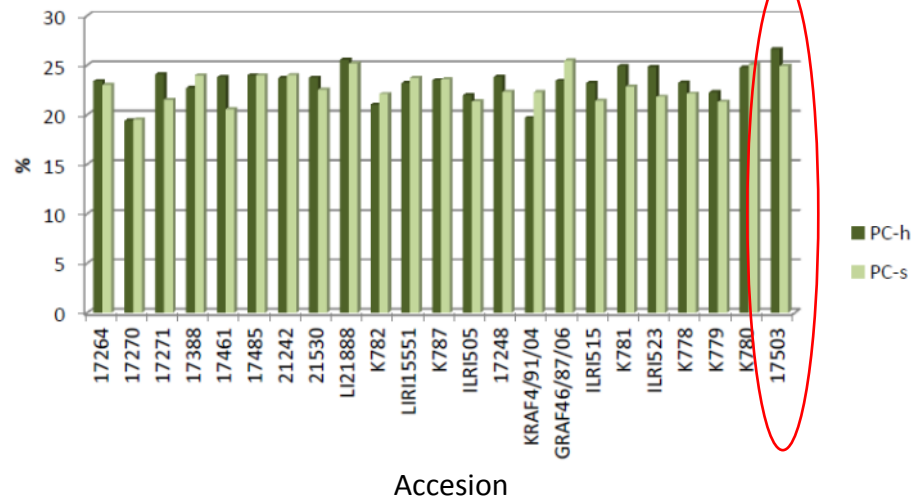
NDF



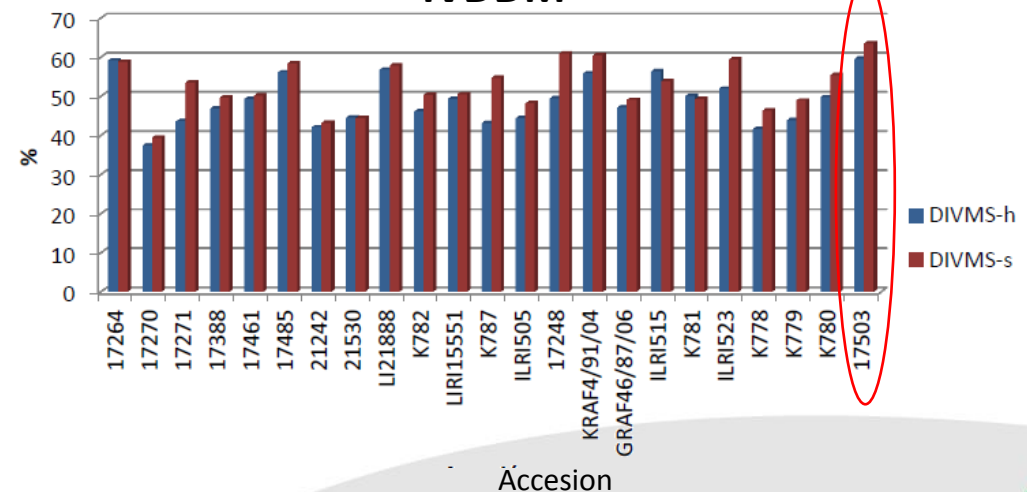
ADF



CP



IVDDM



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Field evaluation of a collection of the forage legumes shrubs *Leucaena diversifolia* and *Leucaena trichandra*



A collection of 61 accessions was planted in jiffy pots in the green house (50 accessions of *L. diversifolia* and 11 of *L. trichandra*)

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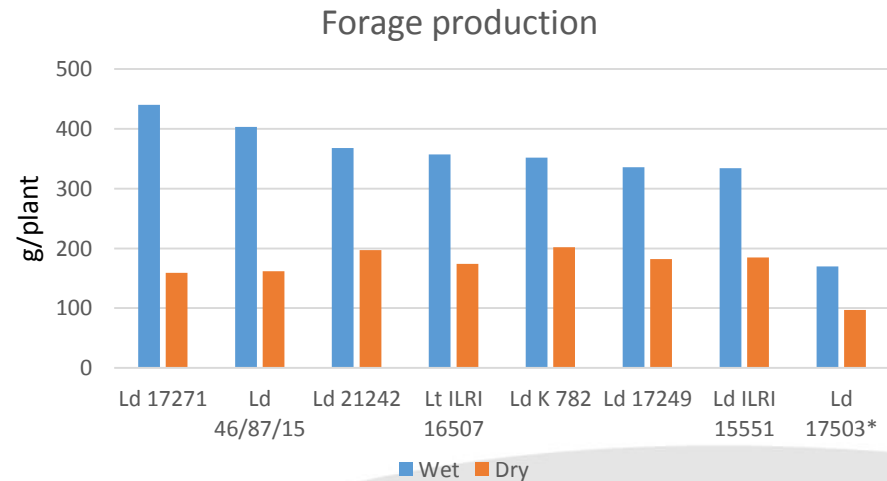
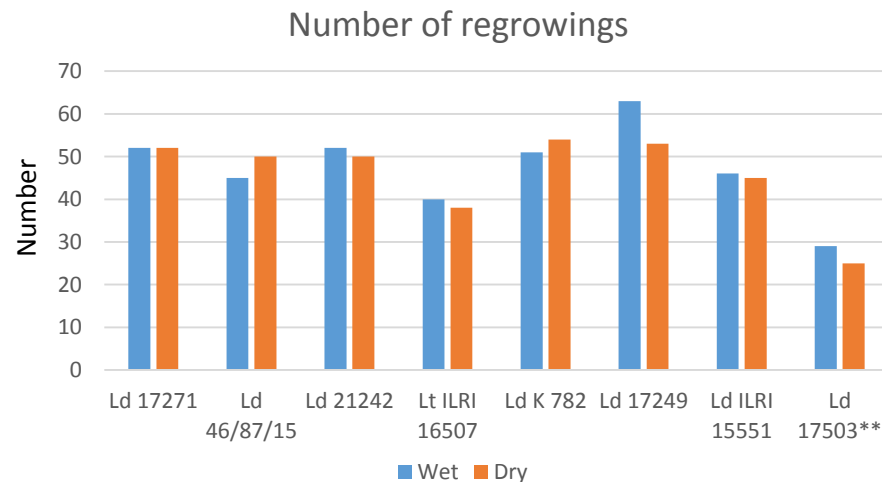
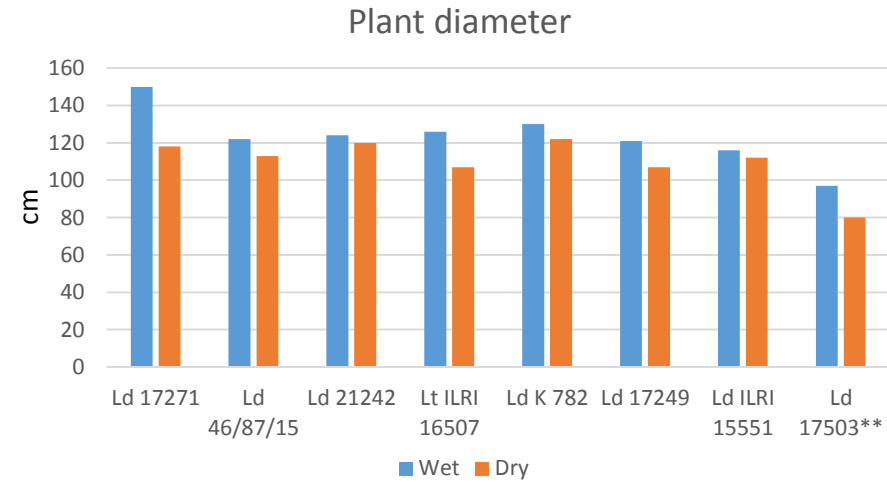
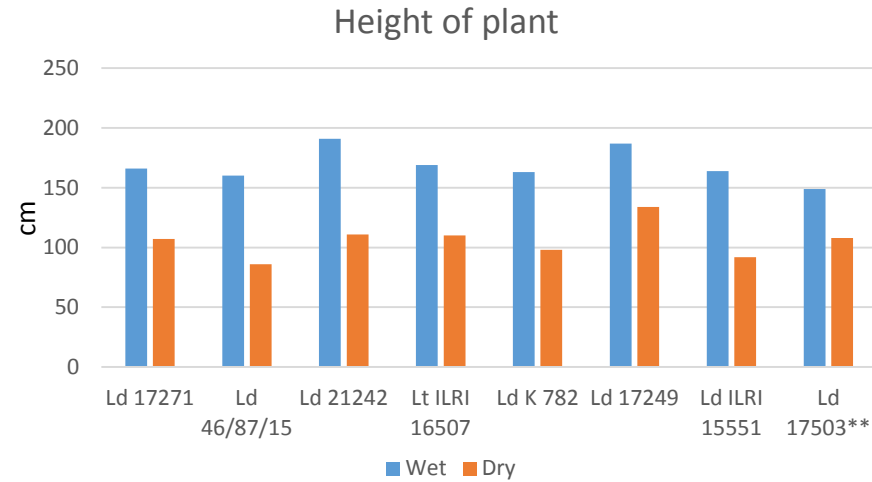
Field evaluation of a collection of the forage legumes shrubs *Leucaena diversifolia* and *Leucaena trichandra*



CIAT accession 17503 was included as control as there is data available from previous evaluations, including regional evaluations.

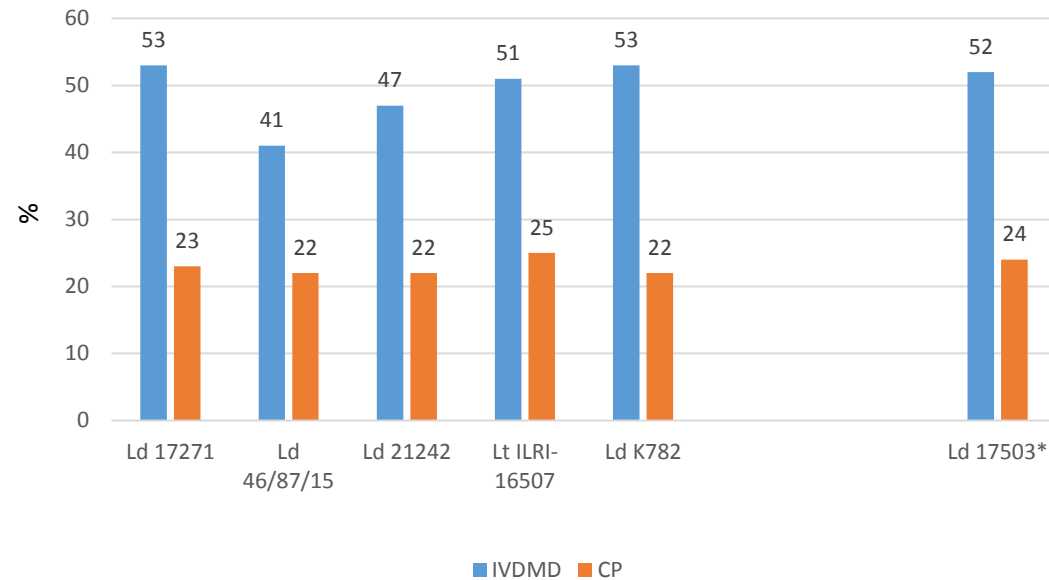
A randomized block was employed, with three replications for agronomic and forage quality evaluation, and one for morphological characterization. Each replication consisted of five plants per accession. The plants were spaced 1 m, with 1.5 m between rows

Agronomic and production evaluation



Nutritional characterization

Nutritional Characterization



Tannin content of selected accessions of *Leucaena diversifolia* and *L. trichandra* in the wet and dry season in Quilichao, 2005-2006.

Species and accession No.	Wet			Dry		
	Tannins, soluble	Tannins, insoluble	Tannins, total	Tannins, soluble	Tannins, insoluble	Tannins, total
Ld 17271	13.7	2.7	16.5	13.8	3.4	17.3
Ld K 782	4.7	3.2	7.9	10.8	4.2	15
Ld 17249	11.4	3.2	14.6	6.4	2.2	8.6
Lt ILRI 16507	12.1	2.9	15.1	16.4	3.2	19.6
Ld 21242	14.2	2.4	16.6	18.3	3.1	21.5
Ld 17503*	12.6	4.6	17.2	24.4	3.8	28.3

Silvopastoral test at CIAT to evaluate the productive and environmental parameters with combinations of grasses and legumes

Polytunnels with capacity for simultaneous measurement of CH₄ of four animals

Treatments:

T1: *Brachiaria* hybrid cv Cayman.

T2: *Brachiaria* hybrid cv Cayman + *Canavalia brasiliensis*.

T3: *Brachiaria* hybrid cv Cayman + *Canavalia brasiliensis* + *Leucaena diversifolia*.

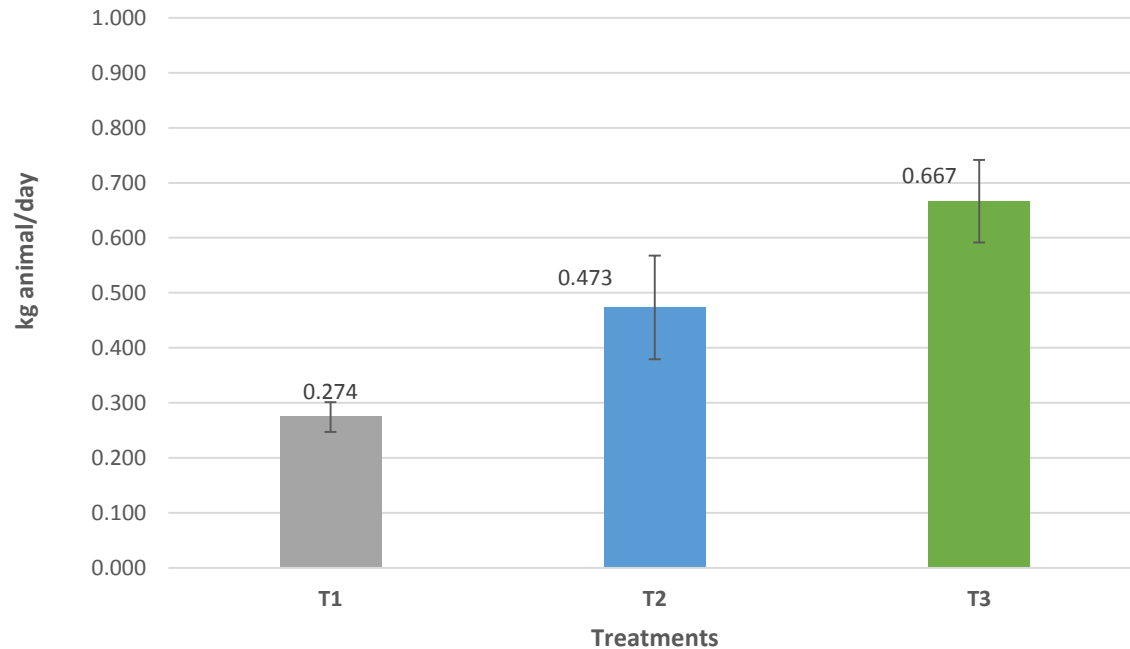


Purpose:

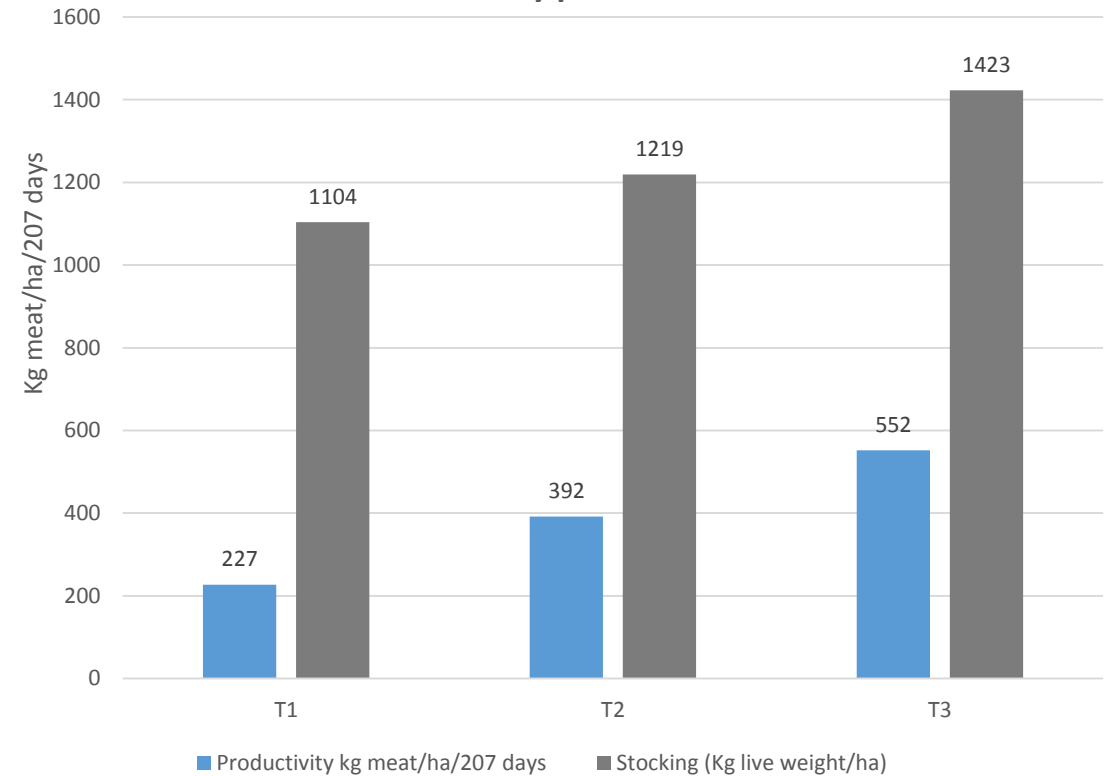
- To determine the weight gain (g/ Animal / day) of steers under grazing in plots with grasses alone and associated with herbaceous and shrub legumes
- Compare traditional management that gives a farmer to his farm vs a Silvopastoral system

Silvopastoral Sistem

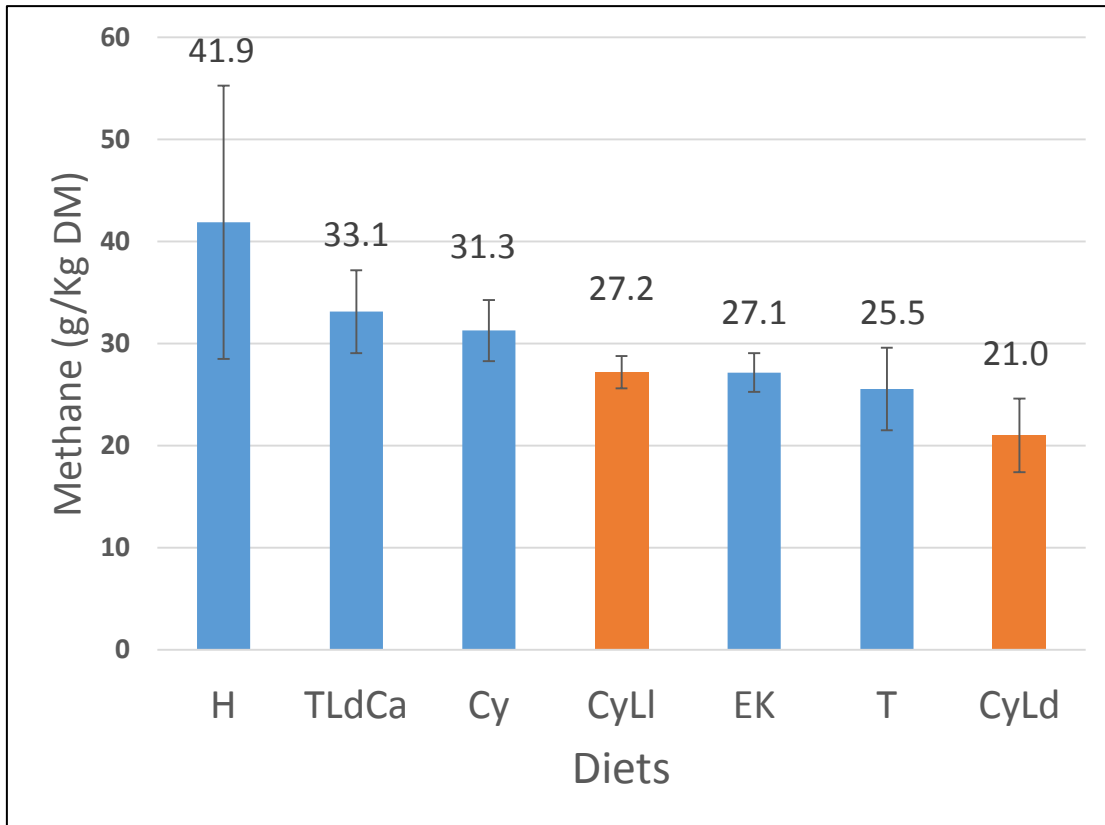
Daily weight gain



Productivity per hectare



Enteric methane emissions per Kg of dry matter intake



- **H:** Hay of *Dichanthium aristatum* (Angleton)
- **TLdCa:** *Brachiaria brizantha* cv. Toledo + *Leucaena diversifolia* ILRI 15551 + *Canavalia brasiliensis* CIAT 17009
- **Cy:** *Brachiaria* Hibrido CIAT BR/1752 cv Cayman
- **CyLI:** *Brachiaria* Hibrido CIAT BR/1752 cv Cayman + *Leucaena leucocephala* CIAT 17263
- **EK:** *Cynodon nfluensis* (Estrella) + *Pueraria phaseoloides* (Kudzú)
- **T:** *Brachiaria brizantha* CIAT 26110 cv. Toledo
- **CyLd:** *Brachiaria* Hibrido CIAT BR/1752 cv Cayman + *Leucaena diversifolia* ILRI 15551

Animals: 4 Steers of 300 kg in average live weight

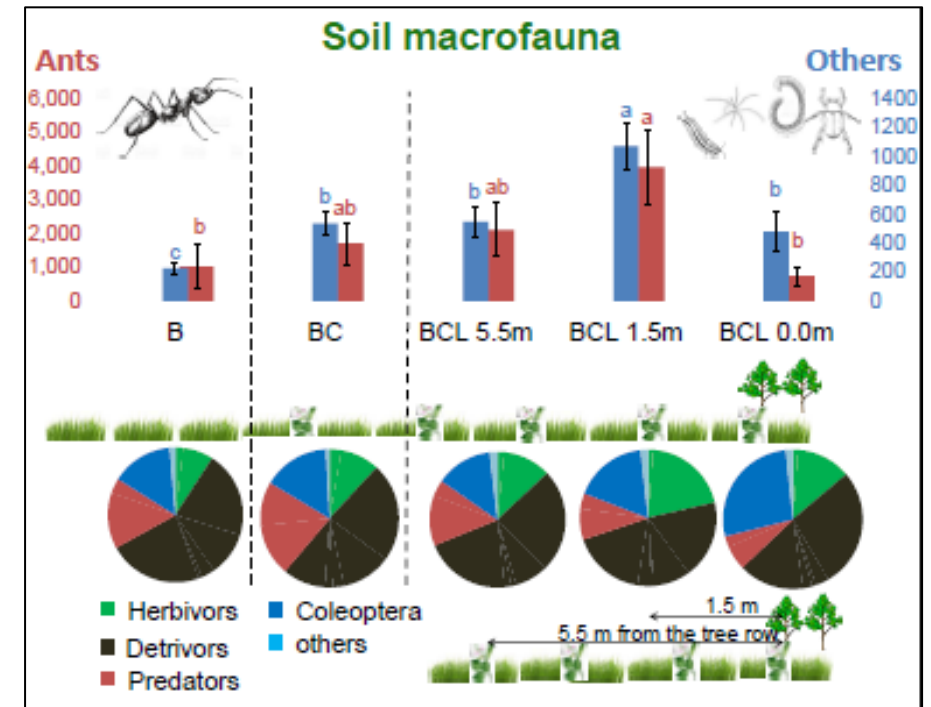
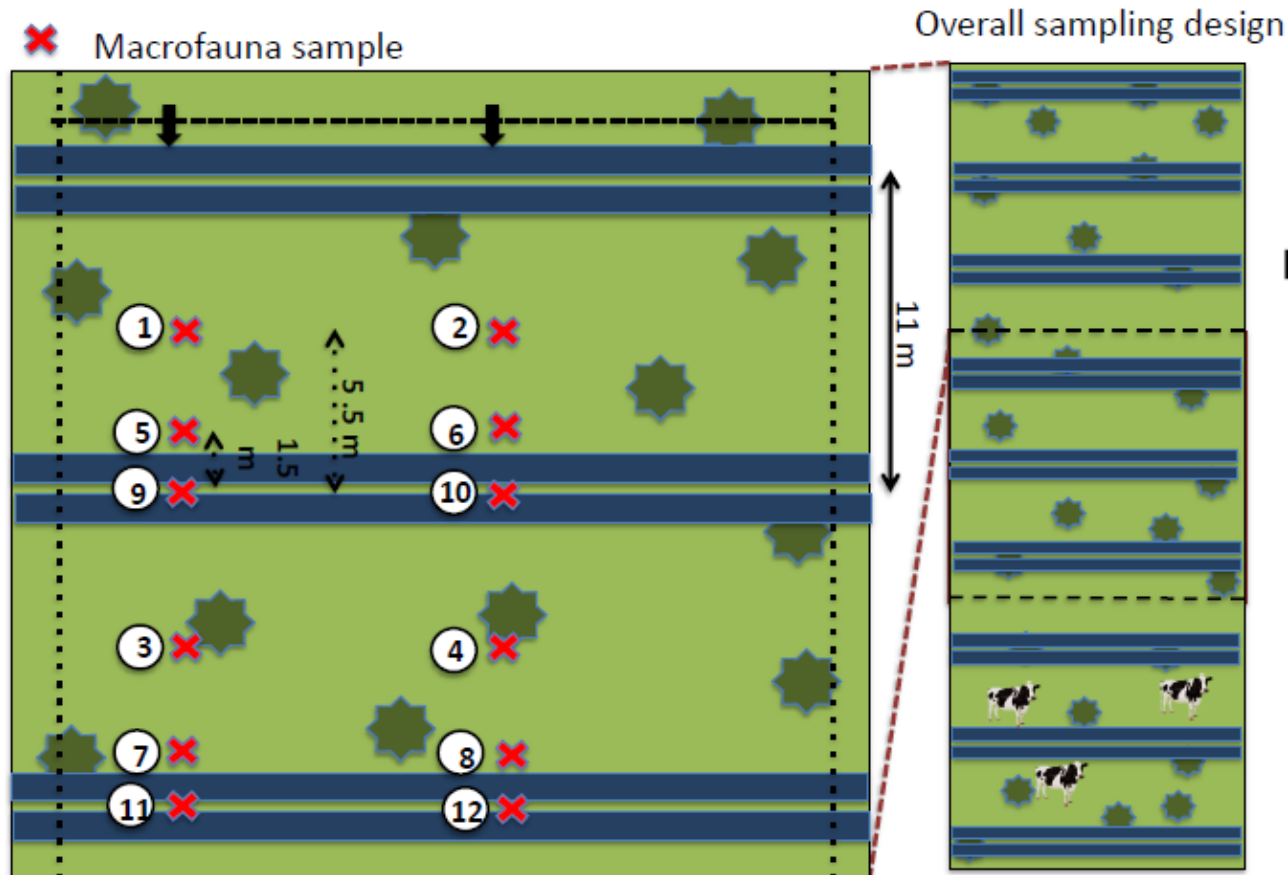


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Soil macrofuna – Silvopastoral trial CIAT 2017

Grazing and soil heterogeneity



Conclusions

- Thanks to the range of adaptation in terms of pH and altitude above sea level, **Leucaena** is an excellent alternative for livestock systems in the tropics.
- Thanks to its nutritional quality and its high digestibility, **Leucaena** can replace to a large extent the supplements used in dairy systems, reducing production costs.
- **Leucaena**, in addition to the benefits for the animal, generates environmental benefits such as the reduction of methane emissions and the contribution of organic matter to the soil, combining it into one of the tools to combat global warming and soil degradation.

Thank you!

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Centro de Investigación de CGIAR

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