Improving Water Management in Integrated Crop-Livestock-Forestry (ICLF) Systems in Central West Brazil

Sarah Glatzle[1], Marcus Giese[1], Roberto Giolo de Almeida[2], Davi Jose Bungenstab[2], Folkard Asch[1]

[1] *University of Hohenheim, Institute of Plant Production and Agroecology in the Tropics and Subtropics, Garbenstr. 13, 70599 Stuttgart, Germany*
[2] *Embrapa Beef Cattle, Av. Radio Maia, 830 – Zona Rural, 79106-550 Campo Grande, MS, Brazil*

E-mail: sarah.glatzle@uni-hohenheim.de

Introduction

The humid tropical climate of central west Brazil mostly provides sufficient rainfall to support year-round agriculture production. However, high rainfall variability during the drier winter is increasingly compromising production. Furthermore, climate scenarios indicate 30 % less rainfall during winter and increasing frequency of dry periods.

ICLF systems are an integrated approach to adapt agriculture to less water availability.

Further in-depth information on how fodder grasses affect the water dynamics in ICLF systems are rare and insufficient to estimate the systems resilience to temporal water limitation and climate change.

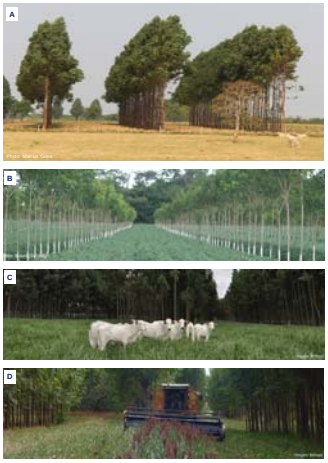

Figure 1: A to D pictures of ICLF systems in Brazil. ICLF systems integrate the crop, livestock/pasture and forest components in rotation, succession or combined in the same area.

Expected results

- **Information about how ICLF systems affect selected components of the field water balance, thereby focusing on water use of the fodder grasses.**
- **Information about productivity in relation to water used in order to characterize the system by water use efficiency traits.**

Aims

- **To contribute to the improved understanding of water dynamics in ICLF systems.**
- **To use the identified water saving and water use efficiency traits of the forage grasses to optimize ICLF systems with regard to sustainability and adaption to climate variability or change.**

Objectives

A) Perform chamber-based laboratory experiments to characterize whole plant transpiration response of common cultivated fodder grasses Brachiaria ssp. and Panicum ssp. to atmospheric drought, soil water limitations and shading.

B) Analyze the water (rain) use efficiency in ICLF systems in contrast to conventional livestock farming systems, thereby focusing on the performance of the fodder grasses Brachiaria spp. and Panicum spp..

C) Analyze growth performance and water use of Brachiaria spp. and Panicum spp. in factorial field trails. Measurements will include root system studies to analyze productivity and water dynamics from a whole plant perspective.

Cultivation design ICLF system

	Summer		Autum			Winter			Spring			Summer
Year / Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008			1	1	1	1	1	1	1	1	2	2
2009	3	3	3	4	4	4	4	5	5	5	6	6
2010	6	6	6	4	4	4	4	7	7	7	7	7
2011	7	7	7	7	7	7	7	7	7	7	7	7
2012	7	7	7	7	7	7	7	7	7	7	7	7
2013	7	7	7	7	7	7	7	7	7	7	7	7
2014	7	7	7	7	7	7	8	7	7	7	6	6
2015	6	6	6	4	4	4	4	7	7	7	7	7
2016	7	7	7	7	7	7	7	7	7	7	7	7
2017	7	7	7	7	7	7	7	7	7	7	7	7
2018	7	7	7	7	7	7	7	7	7	7	7	7
2019	7	7	7	7	7	7	7	7	7	7	7	7
2020	7	7	7	7	7	7	9					

Figure 2: Culivation design of a ICLF system (source: Embrapa Gado de Corte).

1. Soil preparation (tillage, lime and fertilization)
2. Soybean cultivation
3. Planting Eucalyptus while soy beans grows (22 m bet. rows/1,5 m bet. trees)
4. After soy harvest, sorghum or maize is seeded under no-till in combination with Brachiaria
5. Maize/sorghum harvest - Brachiaria surface residue for next soybean no-till seeding
6. Soybean cultivation over Brachiaria using no-till
7. Brachiaria is kept for several years as pasture among the trees - stocking rate is adjusted according to biomass production
8. Every 2nd Eucalyptus row is harvested and sold as fuel wood (more light for next cash crop)
9. Rest of trees are harvested – a new cycle begins

Figure 3: Map of Brazil with location and climate diagram of study area.

Figure 4: Picture of *Brachiaria* ssp. and *Panicum* ssp. cultivated in a greenhouse at the University of Hohenheim.

Materials and Methods

A) Transpiration-chamber experiment

- cultivation of common fodder grasses
- measure transpiration in chamber
- harvest grasses for leaf area and biomass

B) Field trails

- simple weighing lysimeters
- Porometer
- TDR (Time Domain Reflectometry) measurments
- aboveground net primary production (moving cage method)
- belowground net primary production (ingrowth core method)

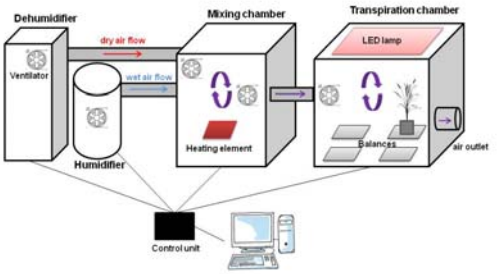

Figure 5: Sketch of Transpiration-chamber.

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www.water4use.info

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Av. Radio Maia, 830 – Zona Rural, 79106-550 Campo Grande, MS, Brazil
www.cnpgc.embrapa.br