

# Finding a consensus on the effects of tropical legume silages on intake, digestibility and performance in ruminants: A meta-analysis

Dr. agr. Joaquín Castro-Montoya

Animal Nutrition and Rangeland Management  
in the Tropics and Subtropics



XVIII International Silage Conference  
26<sup>th</sup> July, 2018

# Feeding ruminants with forage legumes



UNIVERSITY OF  
HOHENHEIM

2

## The temperate experience



*Medicago sativa*



*Trifolium pratense*

Compared with grasses:

- Higher crude protein content
  - Lower fiber content
- Higher digestibility
- High voluntary intake

# Feeding ruminants with forage legumes



UNIVERSITY OF  
HOHENHEIM

3

## The tropical experience



*Lablab purpureus*



*Stylosanthes guianensis*

Compared with grasses and whole crop cereals:

- Higher crude protein content
  - Lower fiber content (?)
- Higher digestibility (?)
- High voluntary intake (?)

# Feeding ruminants with forage legumes



UNIVERSITY OF  
HOHENHEIM

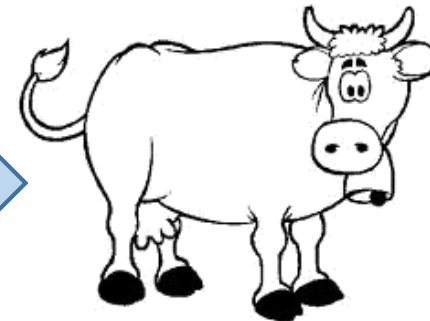
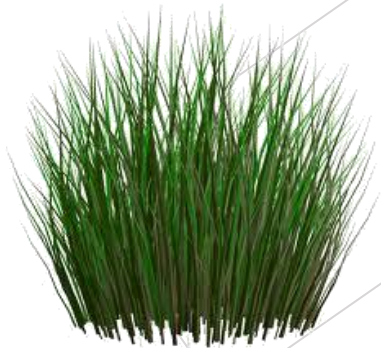
4

## The tropical experience

### The classical legume feeding experiment



Is it the  
legume... Or  
the protein?





# Finding a consensus

## Literature search

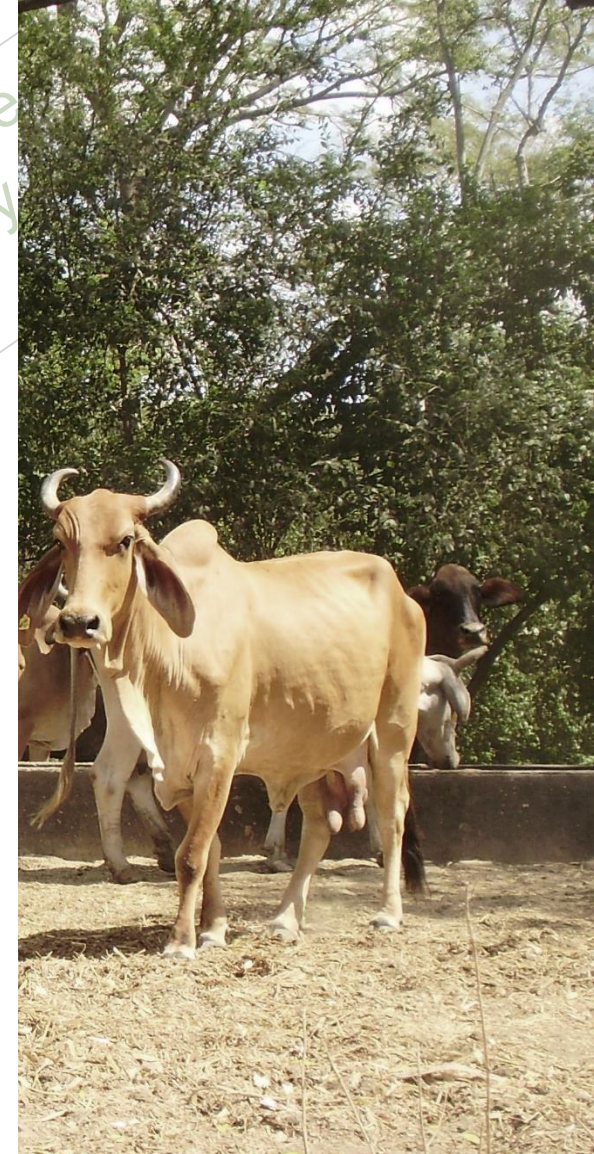


UNIVERSITY OF  
HOHENHEIM

5

### Conditions

- Legumes fed as silage
- *In vivo* studies with ruminants
- In tropical/subtropical regions
- Proportion of legume in the diet, and diet composition
- Measure of dispersion and/or number of observations



# Database summary

## Overview



UNIVERSITY OF  
HOHENHEIM

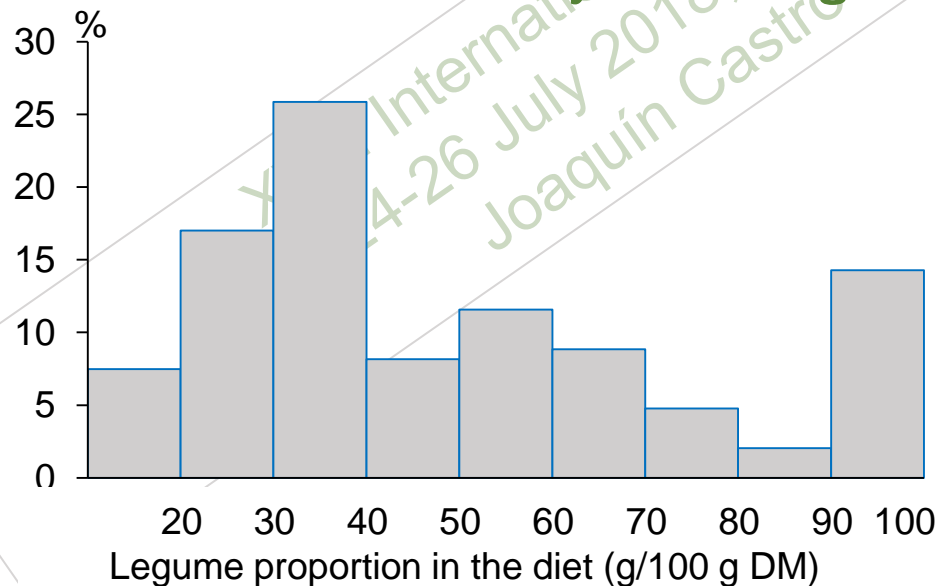
6

### Studies and treatments

51 publications

- 62 trials
- 218 treatments
  - (56 controls, 162 legumes)

### Distribution of treatments by level of legume inclusion



| **METHODOLOGY** |



29 trials with small ruminants



33 trials with cattle

# Database summary

## Legume species

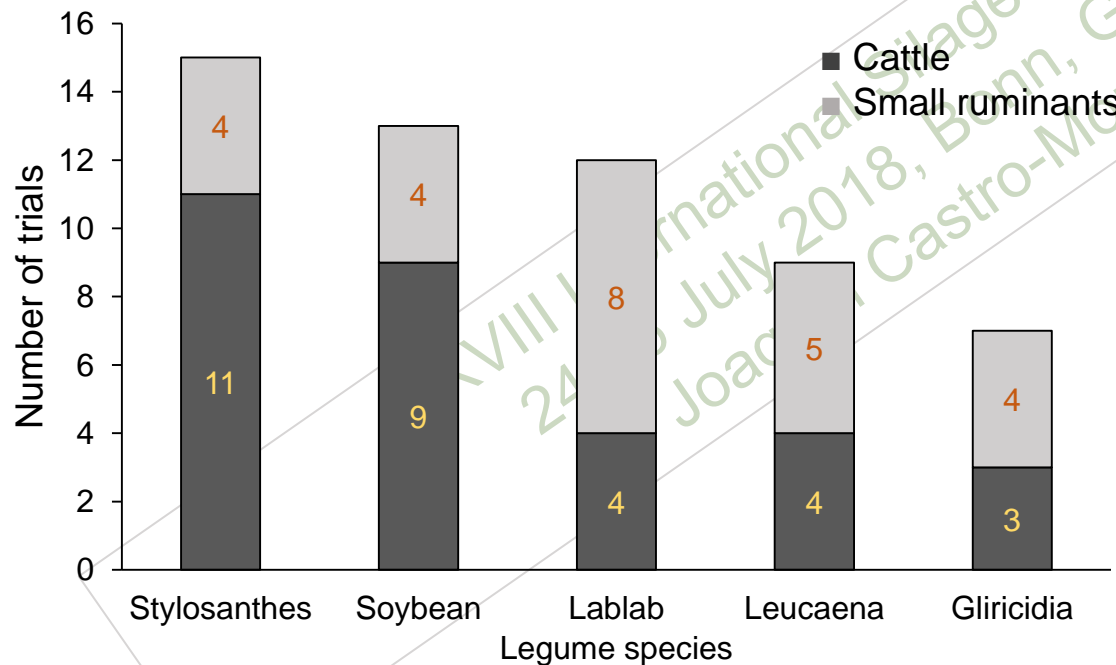


UNIVERSITY OF  
HOHENHEIM

7

### Most common species

- 23 species found
- Herbs, shrubs and trees



29 trials with small ruminants



33 trials with cattle

# Finding a consensus

## Data analyses



UNIVERSITY OF  
HOHENHEIM

8

### Two statistical approaches

Effects of the proportion of legume in the diet

- Regression of diets containing legumes

Comparison of diets without legumes and with legumes at varying levels:

- Control
- 100 to 400 g/kg DM
- 401 to 800 g/kg DM



# Results

# Tropical legume silage feeding

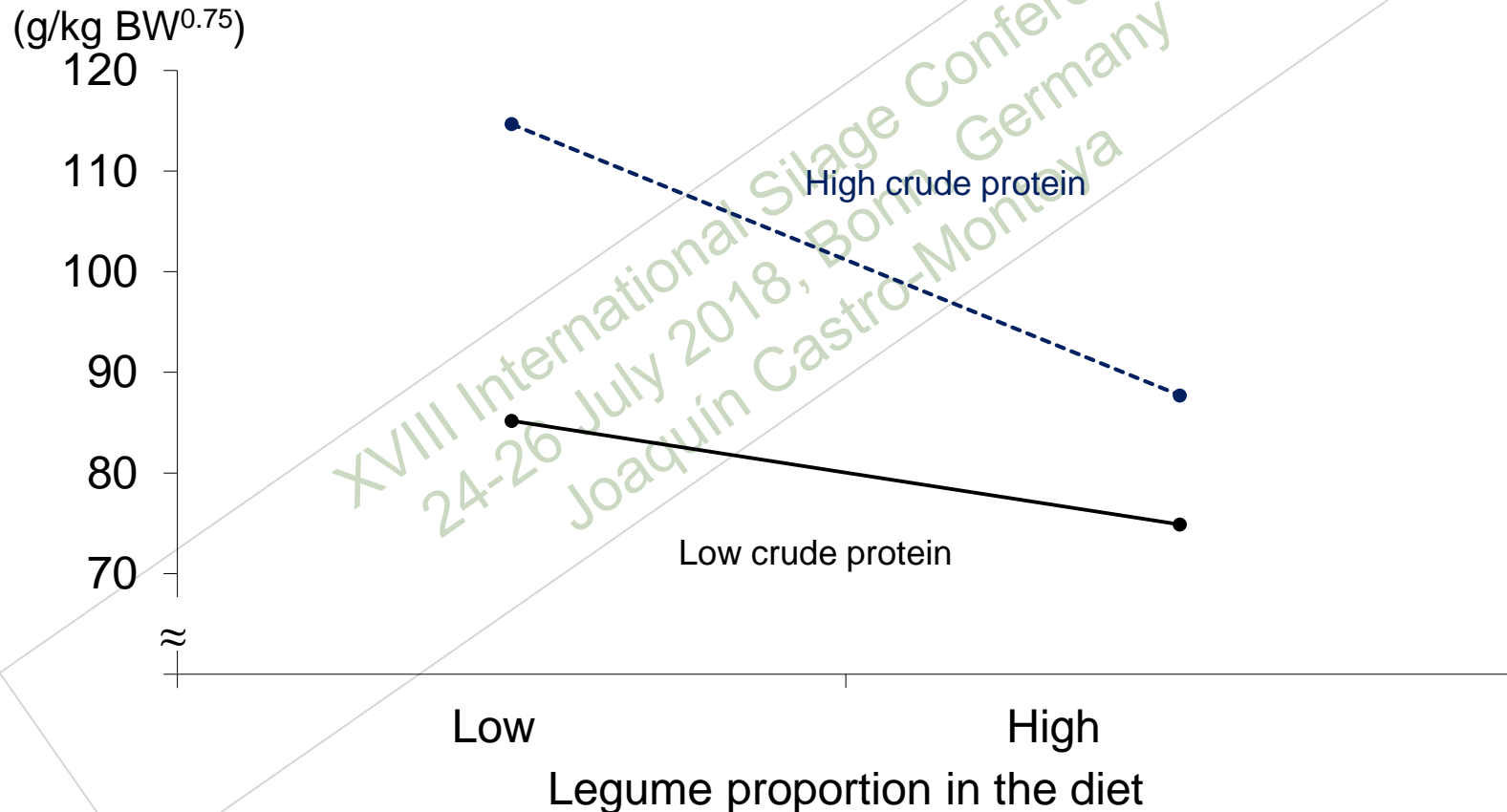
## Effects on intake



UNIVERSITY OF  
HOHENHEIM

10

Dry matter intake per kg metabolic bodyweight



# Tropical legume silage feeding

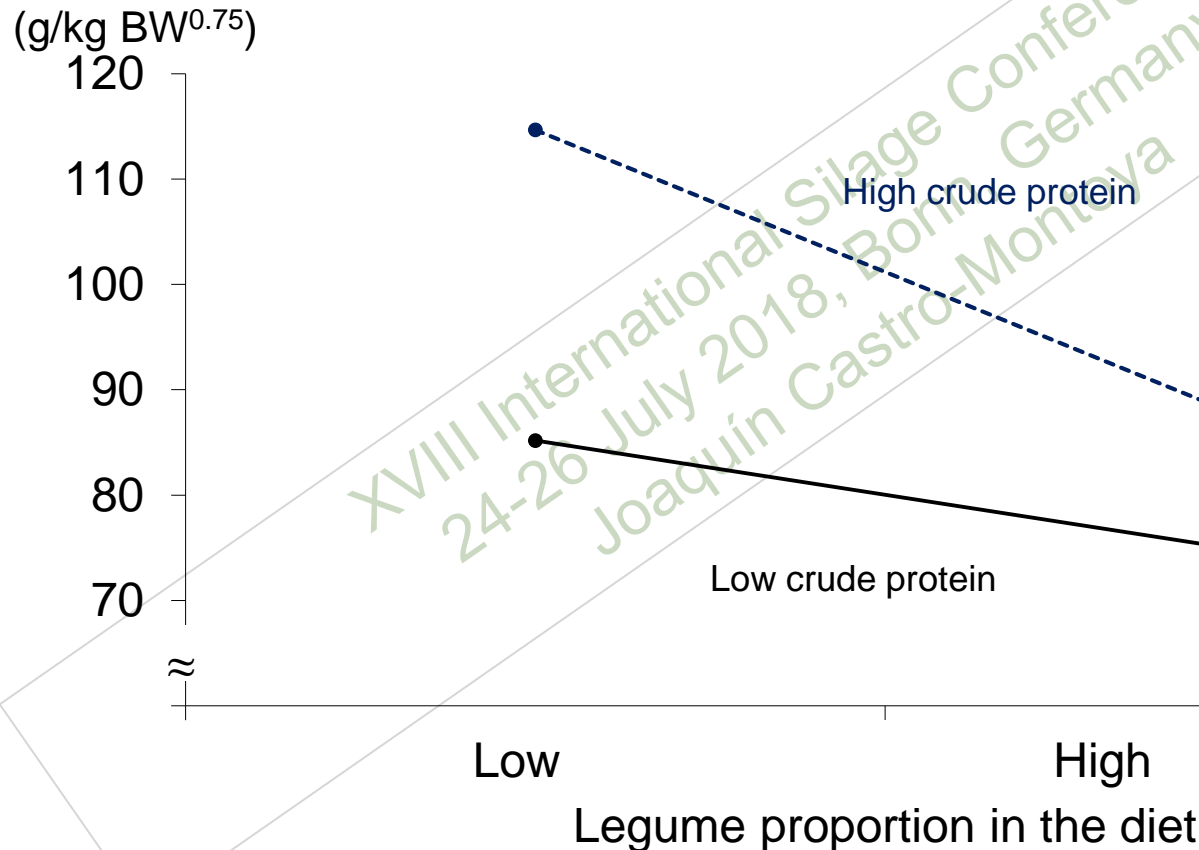
## Effects on intake



UNIVERSITY OF  
HOHENHEIM

11

### Dry matter intake per kg metabolic bodyweight



Fiber content and  
characteristics

Secondary plant  
compounds

Silage fermentation  
products

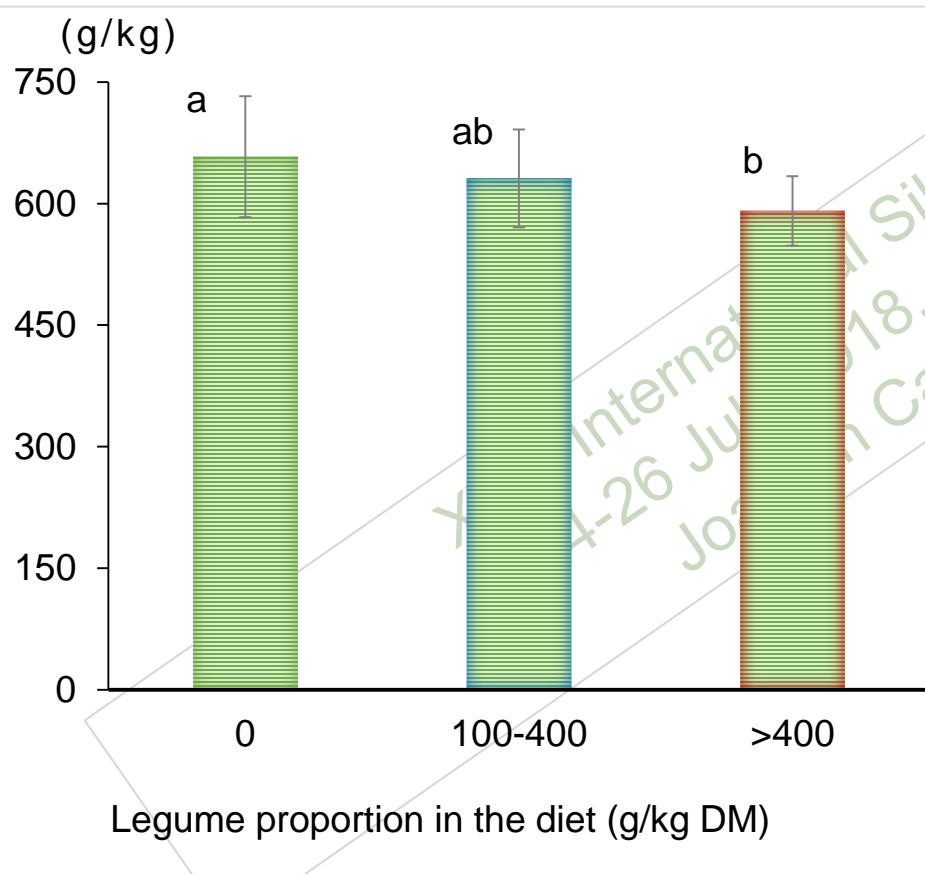
Digestibility

# Tropical legume silage feeding

## Effects on apparent total tract digestibility

12

### Organic matter



Fiber content and characteristics

Passage rate, buoyance

# Tropical legume silage feeding

## Effects on apparent total tract digestibility

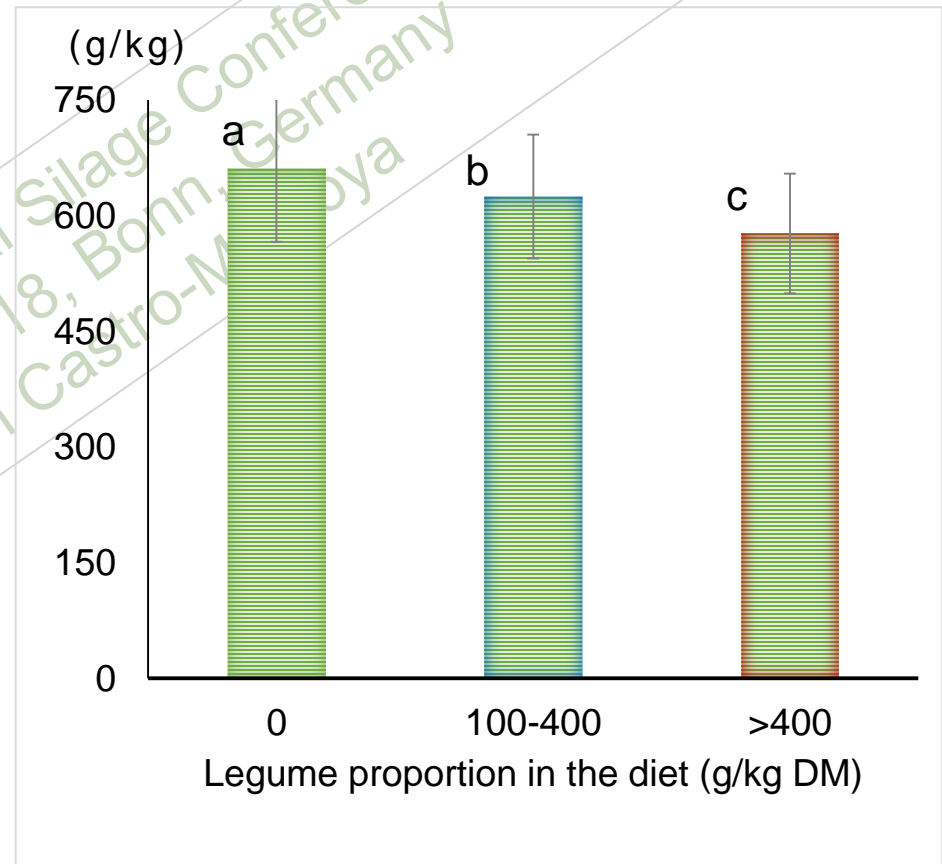
13

### Crude protein

Fiber bound  
nitrogen

Excessive  
heating during  
storage *in silo*

Secondary plant  
compounds





# Tropical legume silage feeding

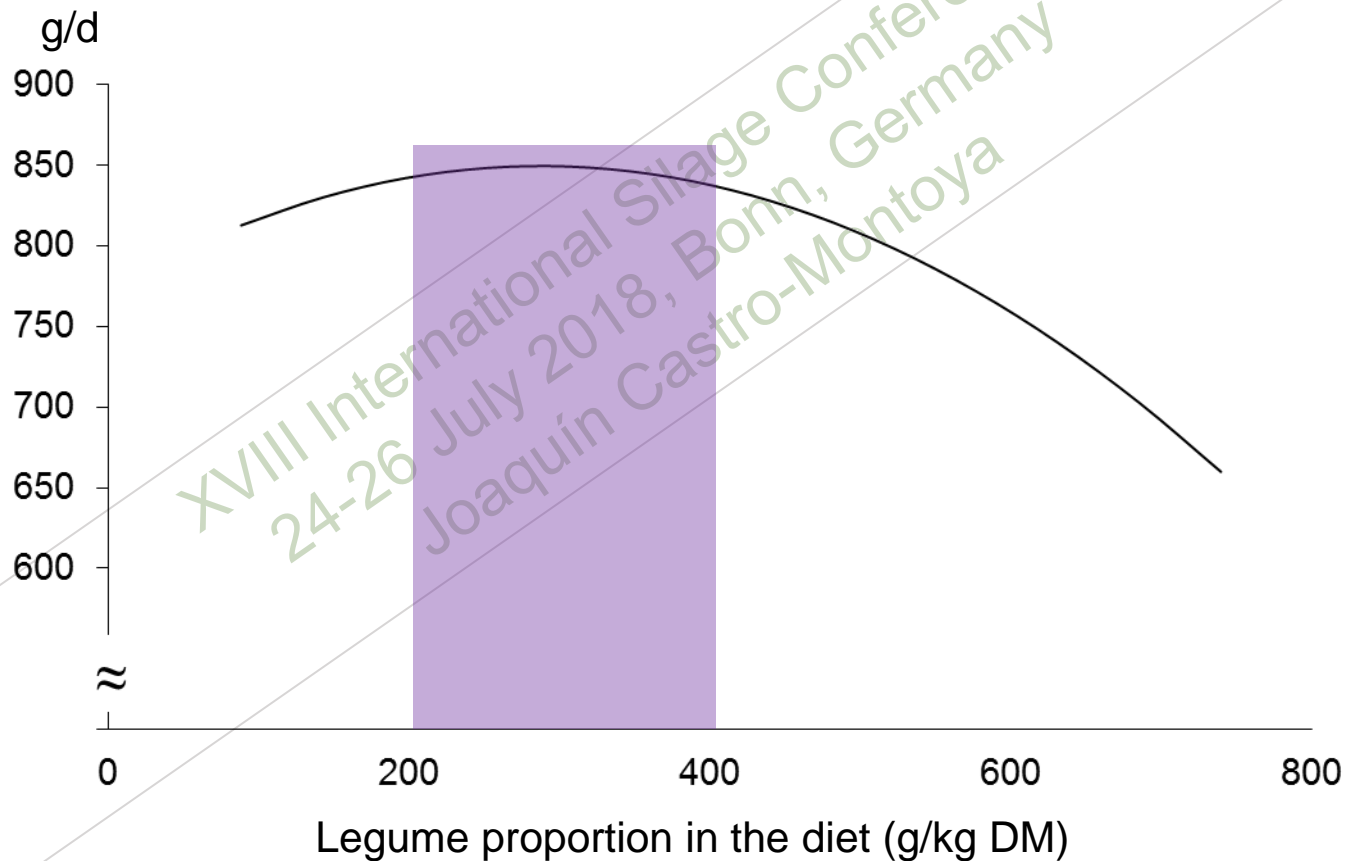
## Effects on performance



UNIVERSITY OF  
HOHENHEIM

14

### Average daily gain



# Tropical legume silage feeding

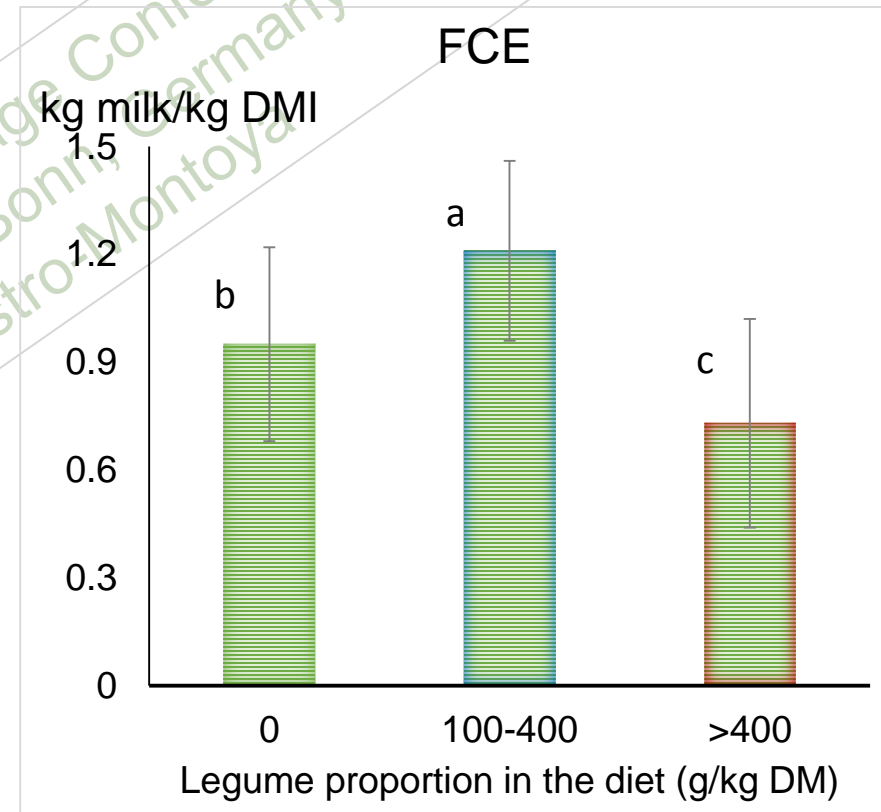
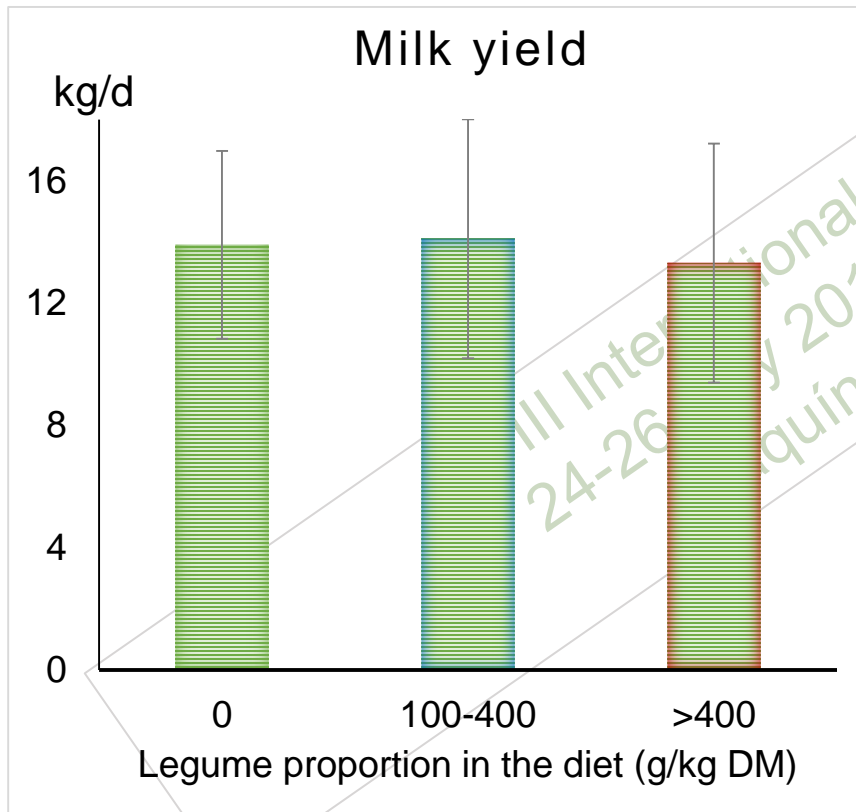
## Effects on performance



UNIVERSITY OF  
HOHENHEIM

15

### Milk yield and feed conversion efficiency (FCE)



# Results

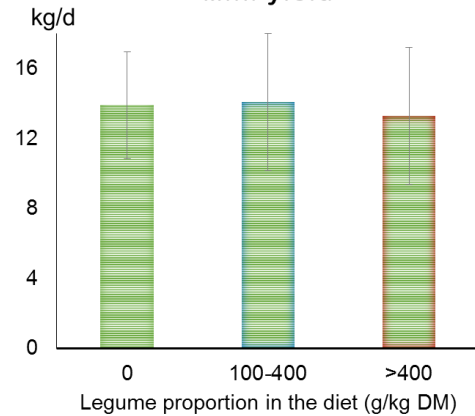
## Tropical legume silage feeding



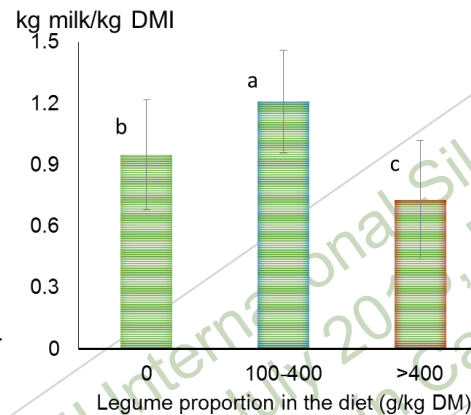
UNIVERSITY OF  
HOHENHEIM

16

**Milk yield**



**FCE**



Rumen  
ammonia  
-N

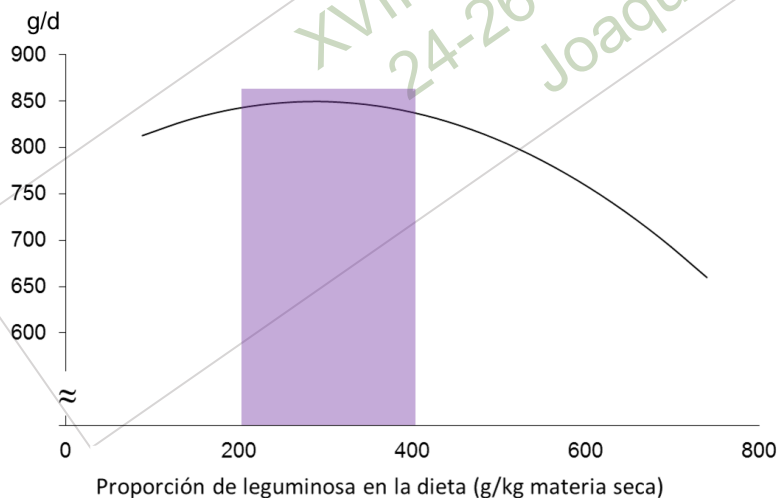
Enhancement of  
microbial protein  
synthesis

N-Energy  
synchroni-  
zation

Urea  
recycling

Supply of dietary  
nutrients

Changes in  
fermentation pattern



| **RESULTS PERFORMANCE**

# Final remarks

## The consensus



UNIVERSITY OF  
HOHENHEIM

17

- Tropical legumes fed as silage
  - Lower intake and digestibility
  - Maintain or increase the performance
    - **Inclusion rates up to 400 g/kg DM**
- Mechanisms of action are still to be understood
  - Further research
- Focus on promising legumes

# Final remarks

## The consensus



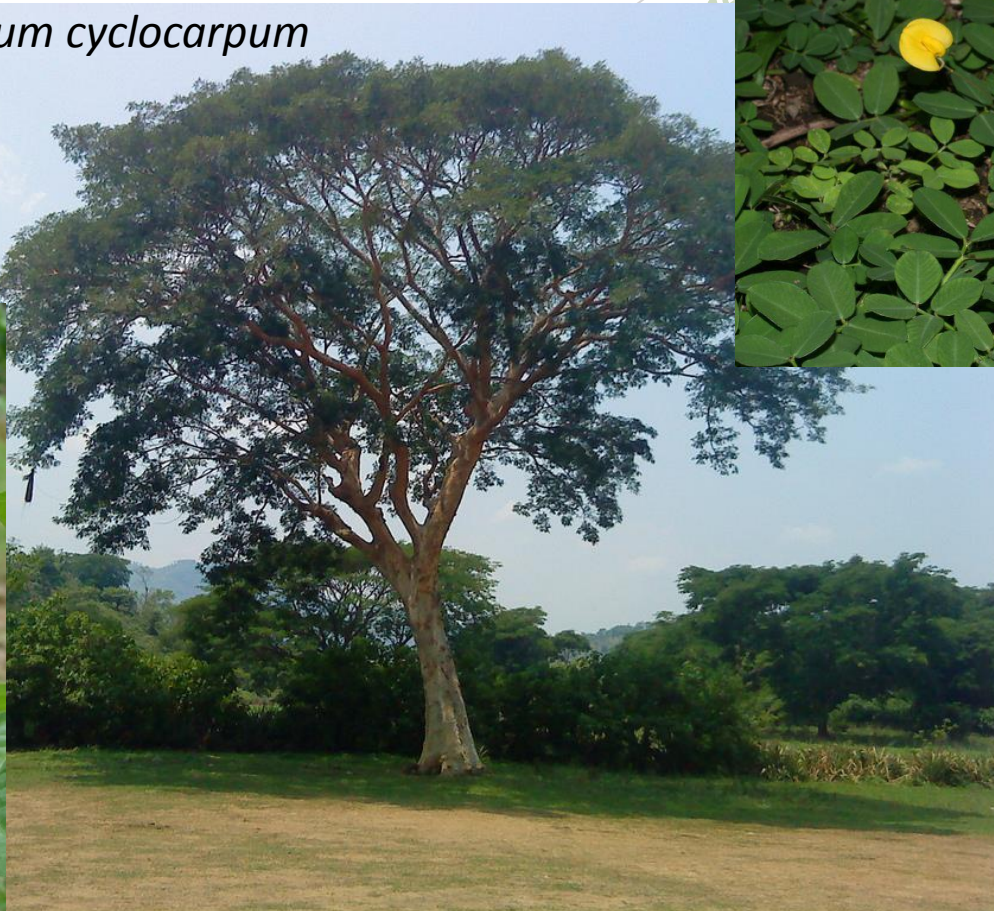
UNIVERSITY OF  
HOHENHEIM

18

## The (other) classical legume feeding experiment

*Enterolobium cyclocarpum*

*Not mechanizable*



*Low biomass*



# Final remarks

## The consensus



UNIVERSITY OF  
HOHENHEIM

19

- Tropical legumes fed as silage
  - Lower intake and digestibility
  - Maintain or increase the performance
    - Inclusion rates up to 400 g/kg DM
- Mechanisms of action are still to be understood
  - Further research
- Focus on promising legumes
  - Quality, quantity, mechanization
    - Lablab, stylosanthes, soybean, cannavalia



# Finding a consensus on the effects of tropical legume silages on intake, digestibility and performance in ruminants: A meta-analysis

Thank you very much!

Contact: [jcm@uni-hohenheim.de](mailto:jcm@uni-hohenheim.de)



XVIII International Silage Conference  
26<sup>th</sup> July, 2018