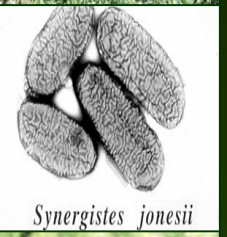





Leucaena for forage: Its use, research, and priorities

1. Introduction
2. Current use as forage
3. R&D findings, including highlights from Int. Leucaena Conf. 2018
4. Future strategies and priorities

Assoc. Prof. Max Shelton

The University Of Queensland

Chichen Itza

- **Origins of *Leucaena***
- Food for several thousand years
- Transported to SEA (Philippines) by Spanish colonists (1600s?)
- Interest in leucaena as forage is recent (~70yrs in Australia)

2. Current use as forage – leucaena has multiple uses

Vegetable for humans

Forage for goats

Anthelmintic for humans and animals

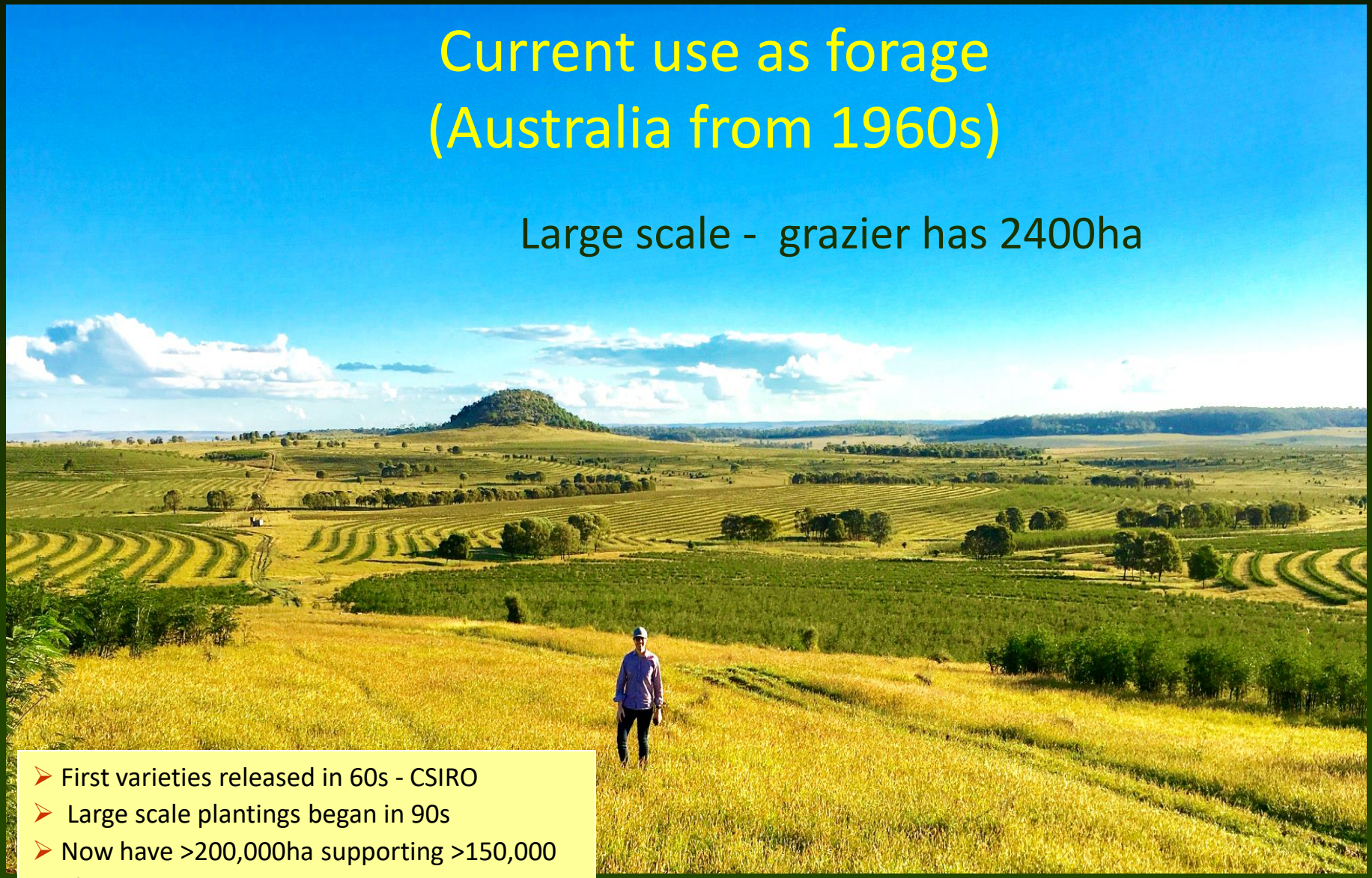
Forage for beef cattle

Wood for paper pulp, fuelwood, bioenergy

Forage for dairy cattle

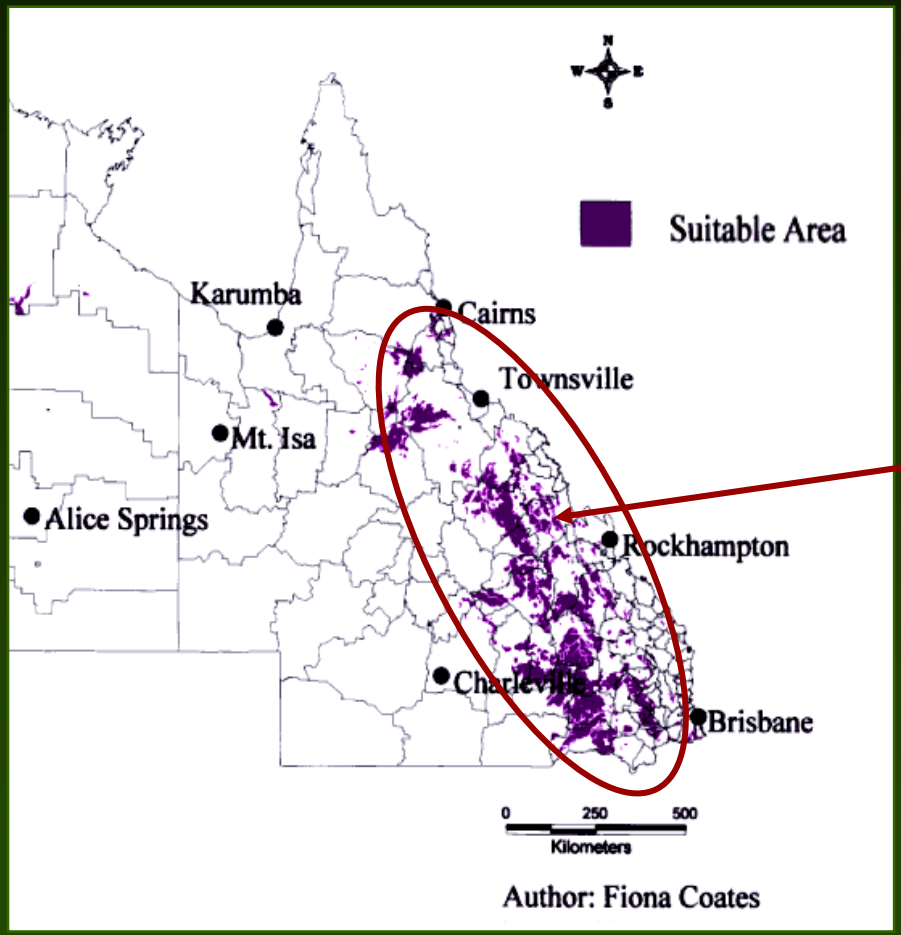
Current use as forage (Australia from 1960s)

Large scale - grazier has 2400ha



- First varieties released in 60s - CSIRO
- Large scale plantings began in 90s
- Now have >200,000ha supporting >150,000 cattle
- Predict >300,000 ha in next 10 years

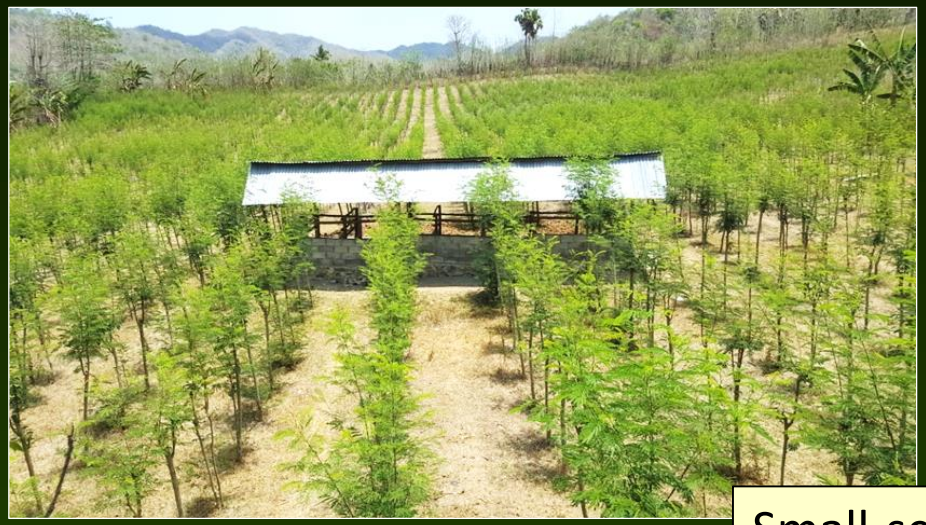
Current use as forage in Queensland (Australia – large scale)



More than 12 M ha of land suitable for leucaena

Central Queensland grazier has 6000ha of leucaena (most have 100-1000ha)

Current use as forage (Southeast Asia - Indonesia)



Small-scale cut and carry fattening

Current use as forage (Latin Americia)

Leucaena for dairy in Mexico

Leucaena for beef in Argentina

Medium-scale for cattle fattening and milk production

Leucaena for beef in Mexico

Leucaena for dairy in Colombia

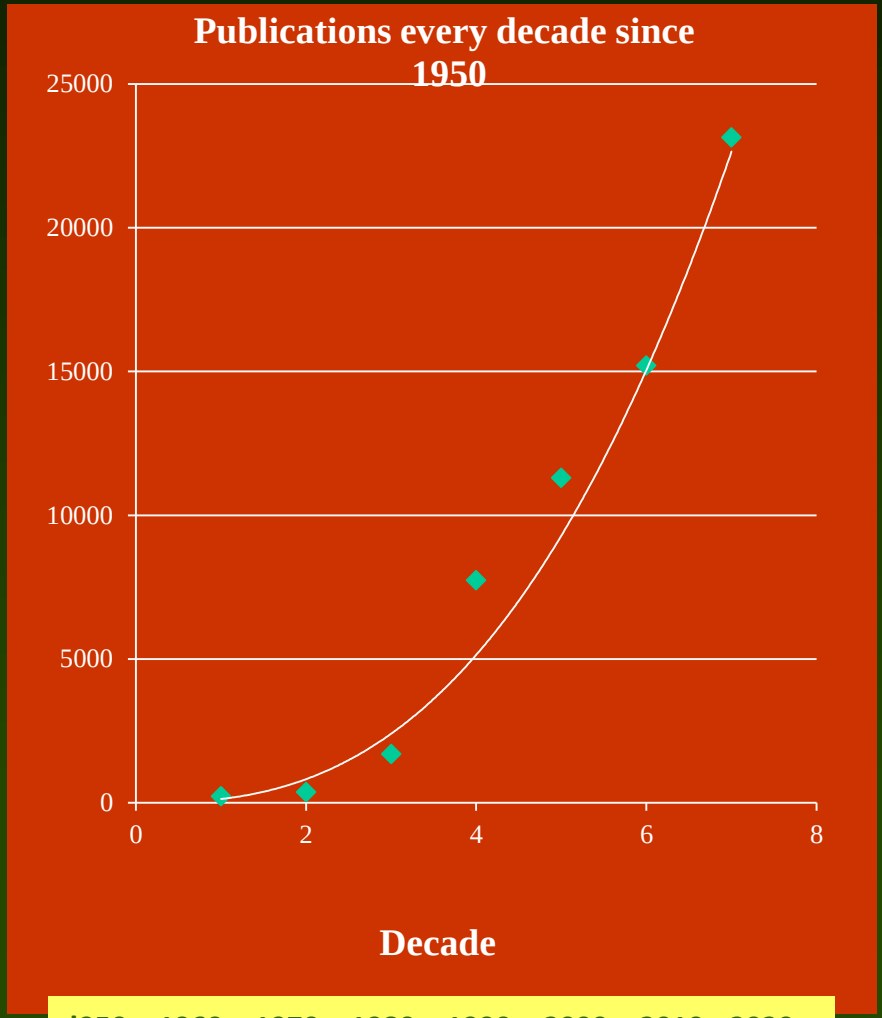
3. Research & Development

Including highlights of International Leucaena Conference - ILC2018 (29 Oct – 3 Nov 2018)

- 3.1 -Leucaena R&D publications
- 3.2 - Animal productivity
- 3.3 - What varieties
- 3.4 - Establishment
- 3.5 - Feeding of animals
- 3.6 - Leucaena toxicity
- 3.7 - Leucaena and environment
- 3.8 - Adoption issues

3.1 Leucaena R&D&E publications (1950-2017)

About 71,000 scientific publications since 1950 (Google Scholar)



3.2 Animal productivity excellent on leucaena around the world

Australia

Thailand

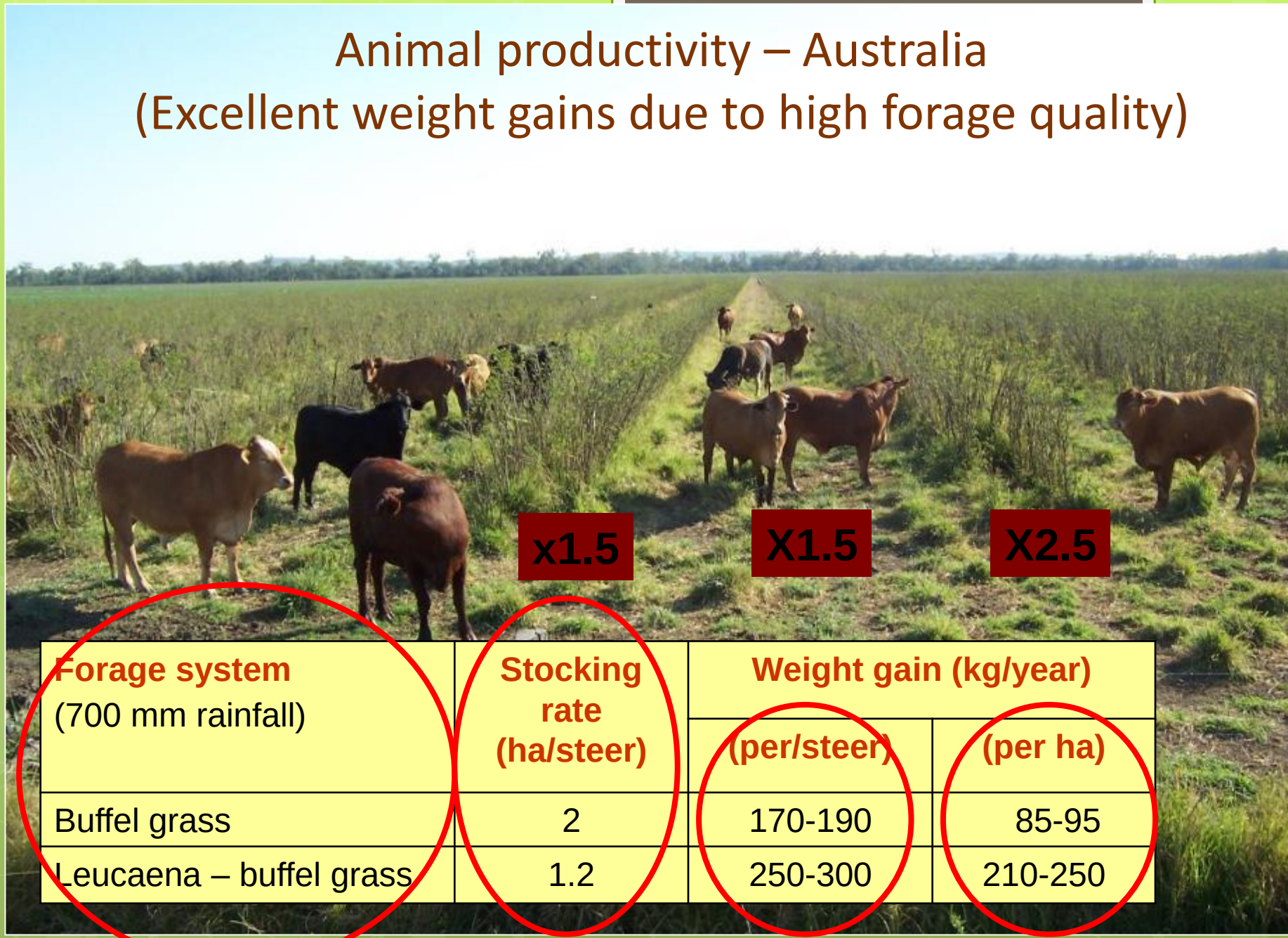
We know that leucaena has:

- High crude protein content (~20% CP in forage)
- High content of essential elements
- Very high palatability and digestibility
- Gives ‘by-pass’ protein
- Anthelmintic properties

Colombia

Indonesia

Animal productivity – Australia
(Excellent weight gains due to high forage quality)



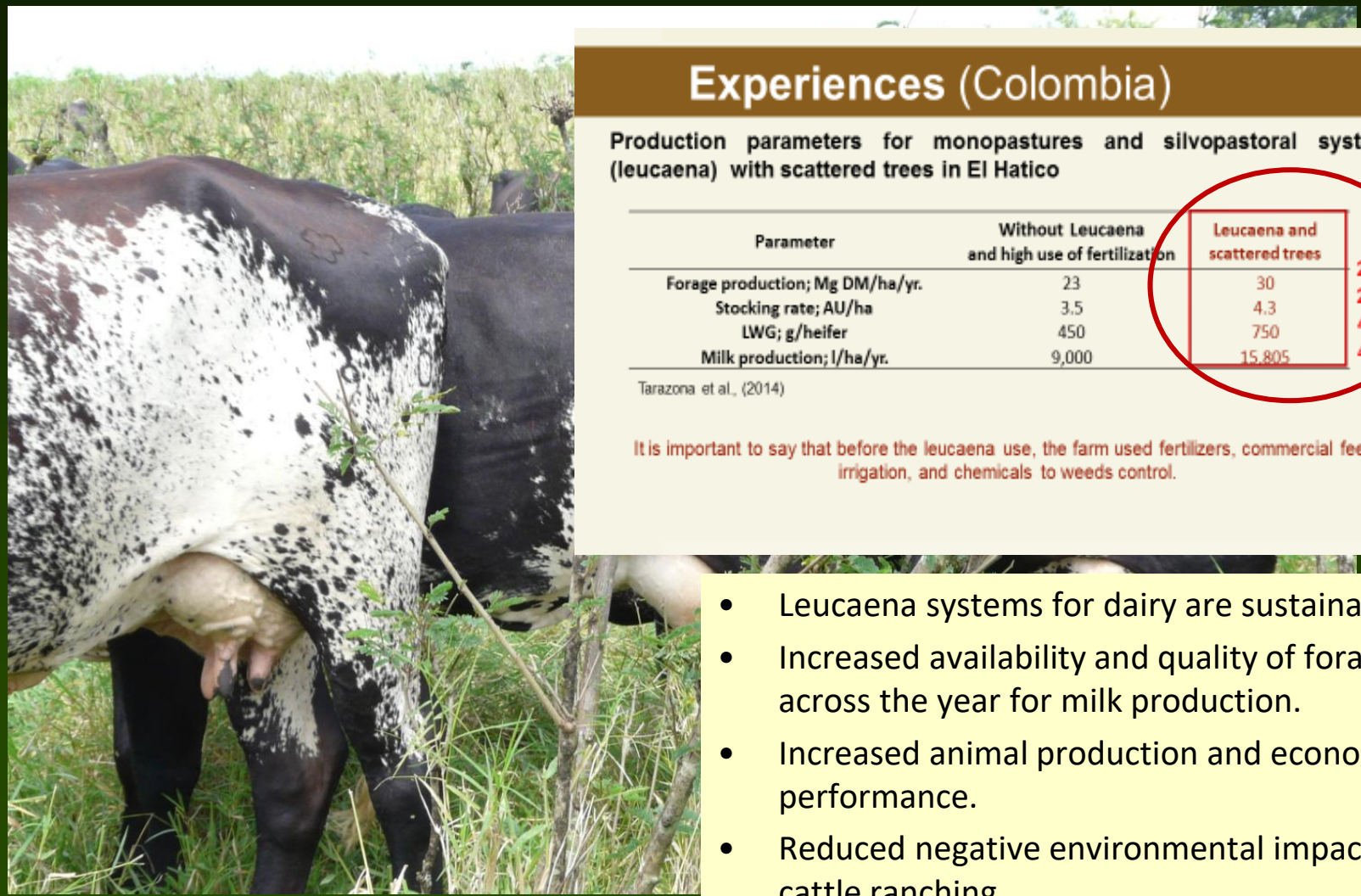
Forage system (700 mm rainfall)	Stocking rate (ha/steer)	Weight gain (kg/year)	
		(per/steer)	(per ha)
Buffel grass	2	170-190	85-95
Leucaena – buffel grass	1.2	250-300	210-250

Animal productivity – Indonesia (Tarramba leucaena for cattle fattening)

Leucaena feeding in Indonesia fattens Bali bulls to near genetic potential (Dahlanuddin et al. 2019)

Animal productivity - Latin Amercia
(Feeding leucaena to dairy cows)

Julian E. Rivera; Julian Chará; Enrique Murgueitio; Juan J. Molina; Rolando Barahon



Experiences (Colombia)

Production parameters for monopastures and silvopastoral systems (leucaena) with scattered trees in El Hatico

Parameter	Without Leucaena and high use of fertilization	Leucaena and scattered trees	
Forage production; Mg DM/ha/yr.	23	30	25%
Stocking rate; AU/ha	3.5	4.3	23%
LWG; g/heifer	450	750	40%
Milk production; l/ha/yr.	9,000	15,805	45%

Tarazona et al., (2014)

It is important to say that before the leucaena use, the farm used fertilizers, commercial feed, irrigation, and chemicals to weeds control.

11

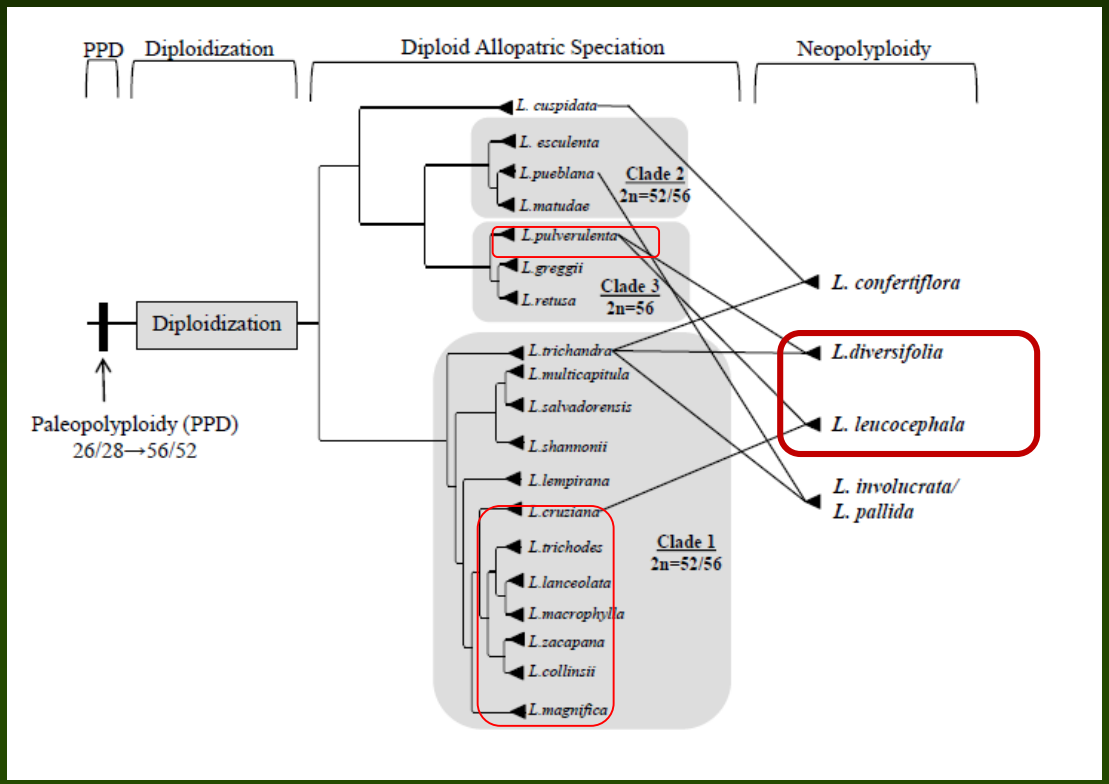
- Leucaena systems for dairy are sustainable
- Increased availability and quality of forage across the year for milk production.
- Increased animal production and economic performance.
- Reduced negative environmental impact of cattle ranching

3.3 *Leucaena* species and varieties

(Abair, Hughes and Bailey 2019)

Leucaena genus comprises 24 species. Of these:

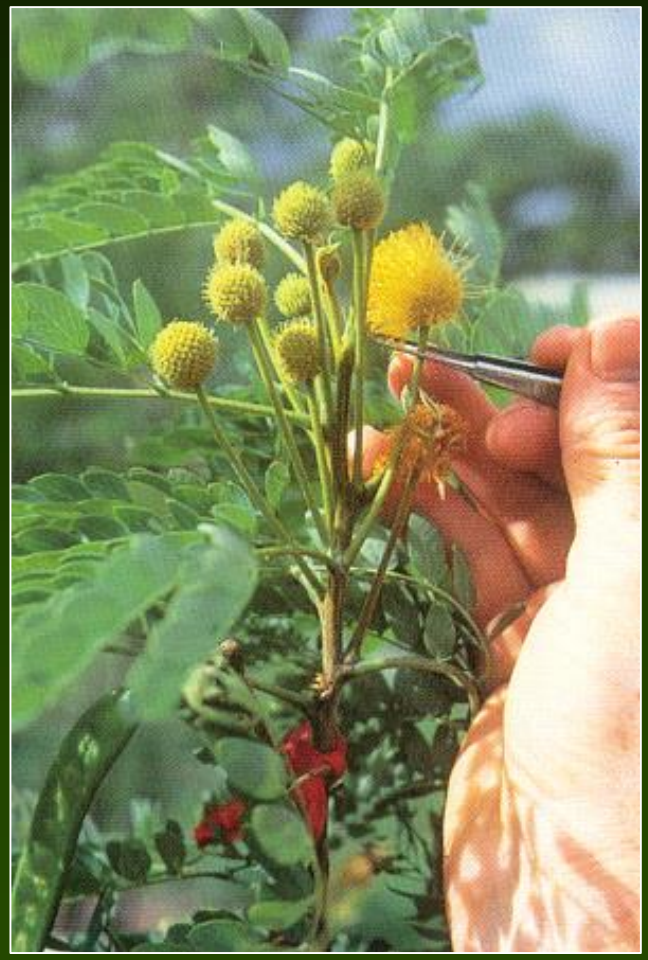
- 19 self-sterile diploid species in three clades, which occupy separate locational distributions
- 5 tetraploid species of hybrid origin (due to anthropogenic backyard allopolyploid formation.



3.3 Leucaena species and varieties (Dalzell 2019)

Dalzell (2019) noted most forage work based on *L. leucocephala*:

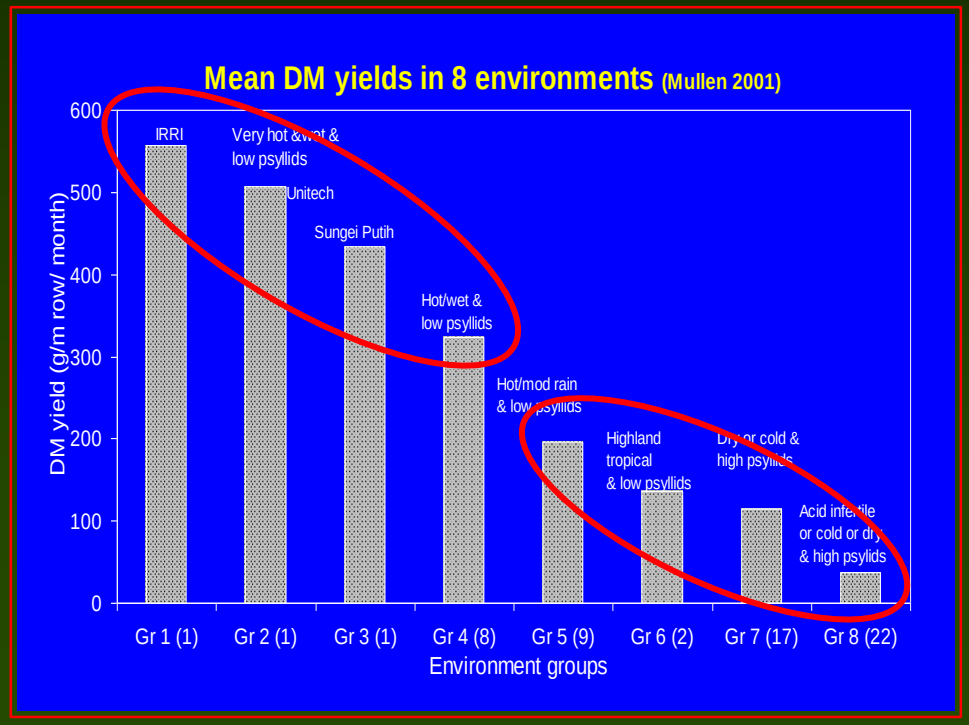
- Early human use of the *Leucaena leucocephala* based ssp. *leucocephala* ('common' leucaena)
- *L. leucocephala* ssp. *glabrata*) identified giving cvv Hawaiian K8, Peru and El Salvador, Cunningham, Tarramba and Wondergraze and in Hawaii as cv. LxL
- First inter-specific variety - psyllid tolerant cvv KX2 leucaena in Hawaii, cv. Redlands in Australia



L. retusa

3.3 Leucaena species and varieties Adaptation (Mullen et al. 2003)

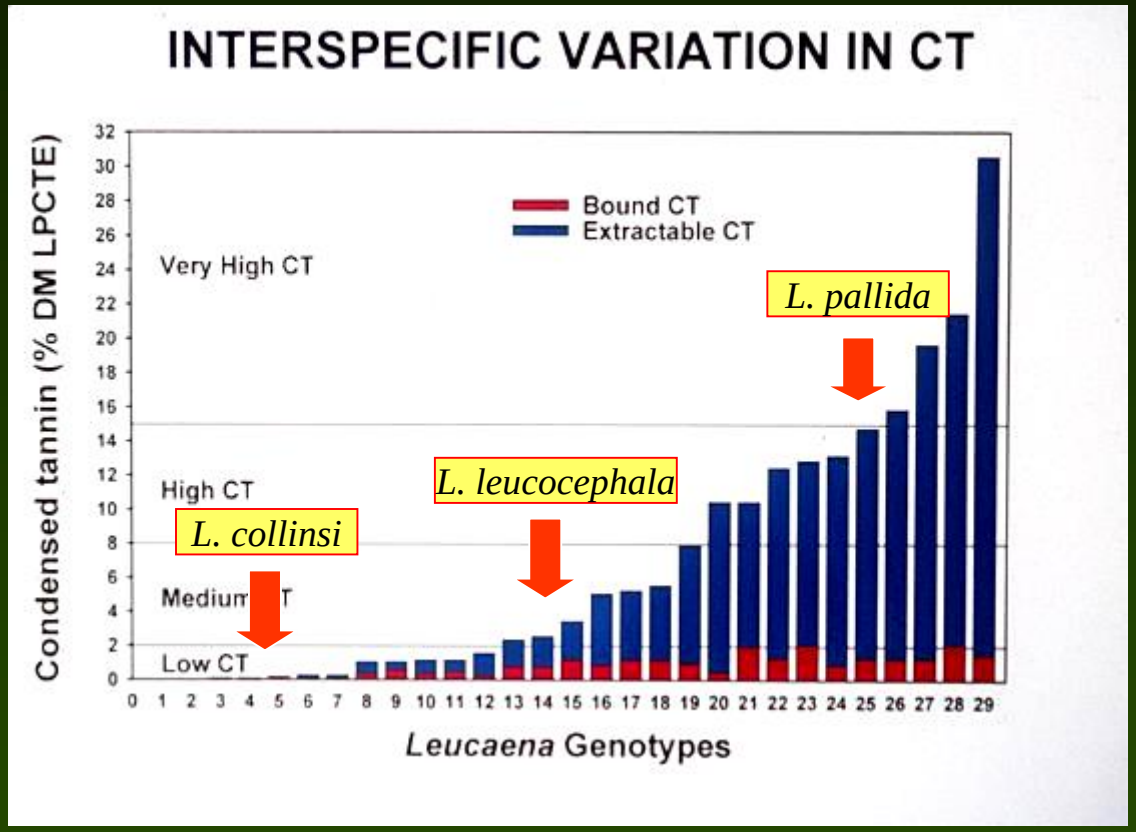
- Multi-environment trials 1995-2000
- 25 representatives, representing 14 spp. and 2 interspecific hybrids
- Planted at 18 sites, 7 countries, range of environments



3.3 Leucaena species and varieties (Forage quality)

Tannins and digestibility (Dalzell et al. 1998)

- **M**ost tree legumes, including *Leucaena* spp., contain tannins
- Good: by-pass protein (*L. leucocephala*)
- Bad: reduce overall digestibility of protein (*Calliandra, Acacia, Flemingia, Prosopis, L. pallida*)
- Most *Leucaena* species are poor in quality



3.3 Leucaena species and varieties

Breeding psyllid resistant variety based on interspecific hybrid between *L. leucocephala* and *L. pallida* (Shelton et al. 2019)

L. Leucocephala
90%

L. Pallida
10%

Exclusive rights to grow and market cv. Redlands leucaena

cv. Redlands June 2017


MOULTRIE
33°C 27.85inHg
REP1
16 MAY 2016 07:39 am

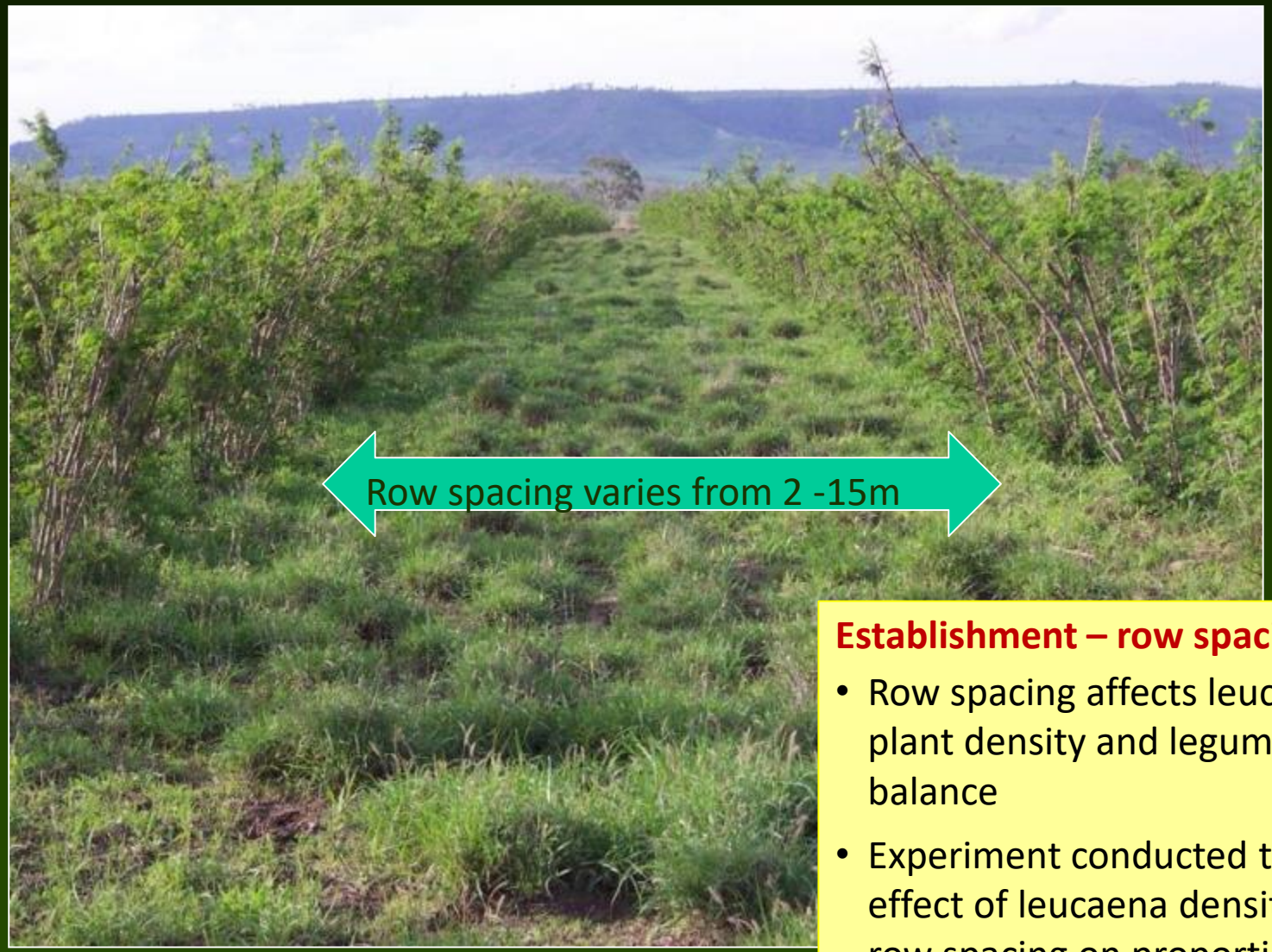
3.4 Establishment and management

(Buck et al. 2019; Pachas et al. 2019; Nulik and Kana Hau 2019)

Establishment

- **Australia:** Mechanized planting, full weed control & fertilizer
- **Southeast Asia:** Seedling and vegetative hand-planting
- **Latin America:** Combination of hand-planting and mechanization

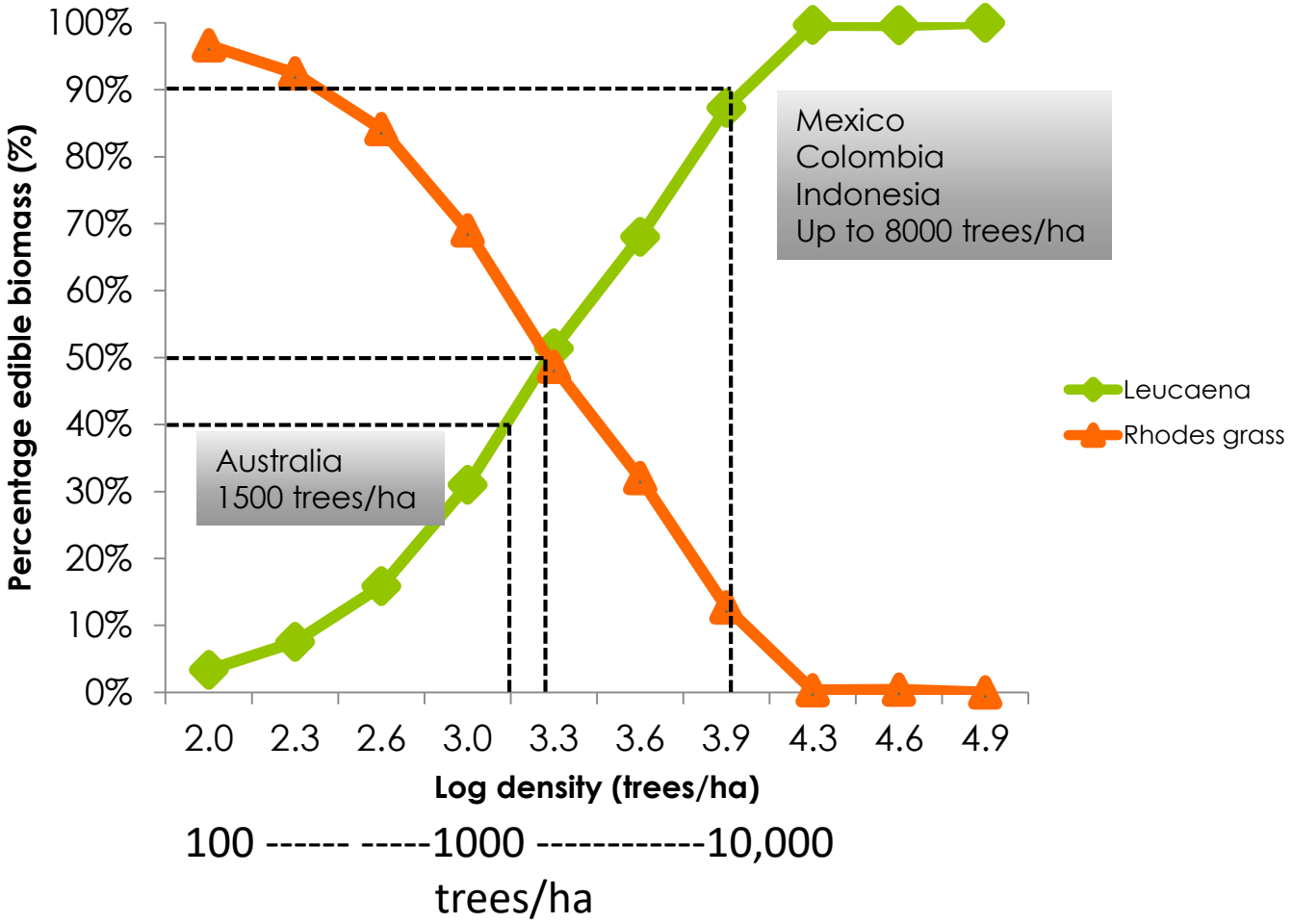
3.4 Establishment and management



Establishment – row spacing

- Row spacing affects leucaena plant density and legume-grass balance
- Experiment conducted to test effect of leucaena density and row spacing on proportion of leucaena and grass

Percentage of grass/legume

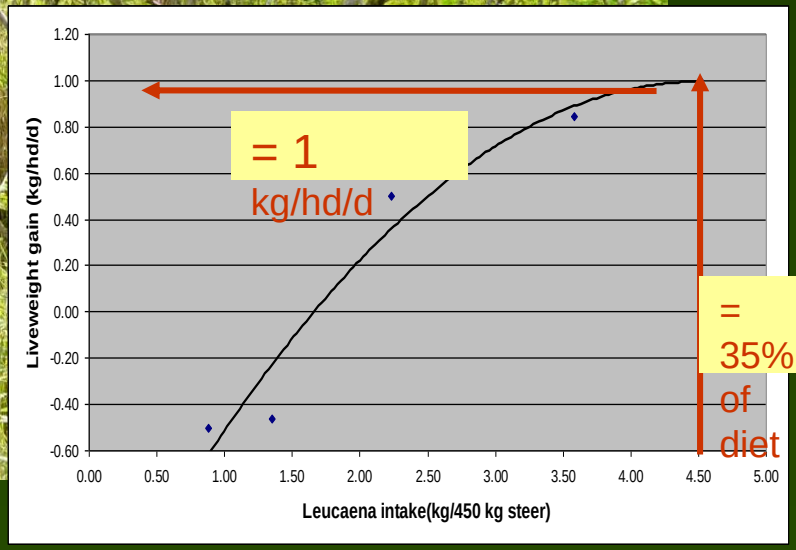


3.5 Feeding and management of animals

Management
Leucaena needs to be intensively managed, but not over-grazed as in Colombia

Height control
Rotational grazing best control of height.
"cut leucaena = lose money, graze leucaena = make money"

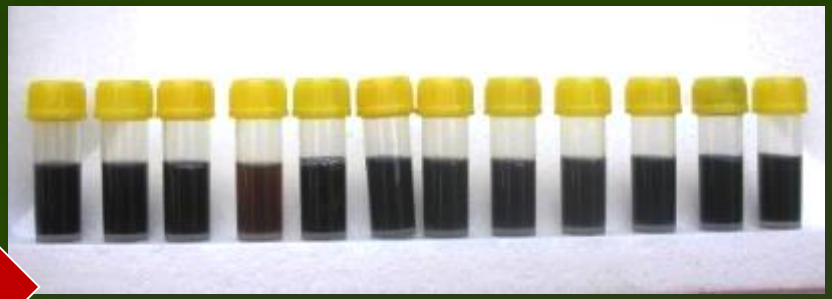
Proportion leucaena in diet
Australia: 0 - 90%
Southeast Asia: often 100%
Latin America: 0 - 100%



3.6 Leucaena Toxicity (is inoculation with *Synergistes jonesii* necessary to prevent toxicity?)

Indonesian cattle not inoculated against toxicity

Indonesian cattle not degrading toxin, but also healthy



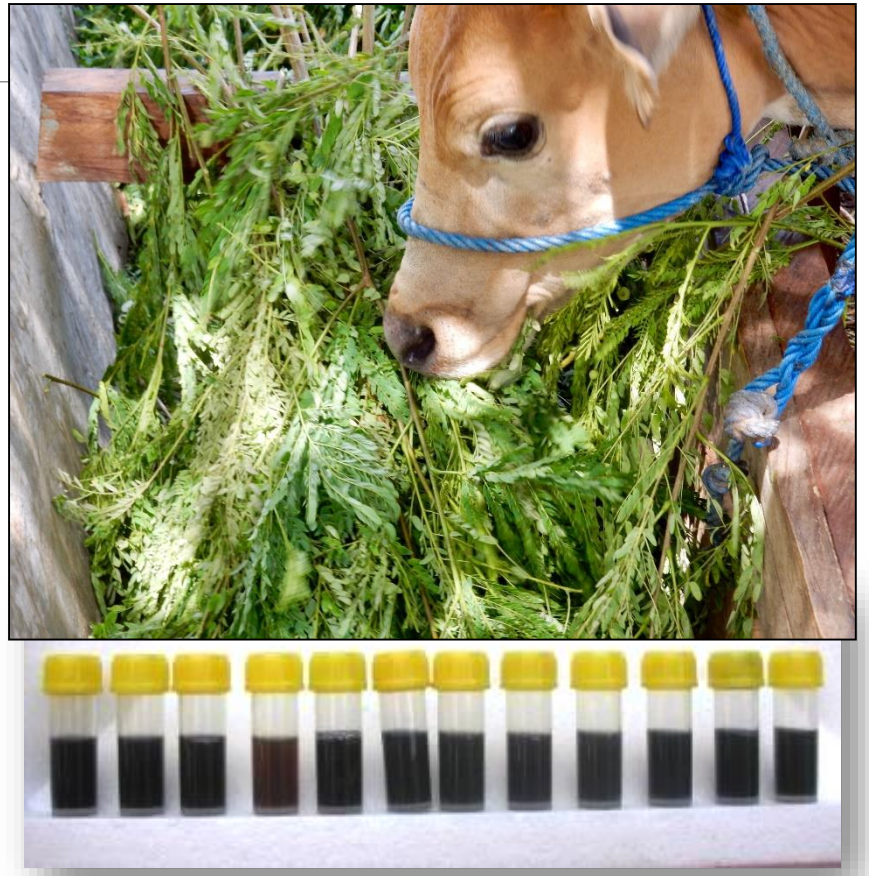
Urine samples showing undegraded DHP

= New Hypothesis for management of toxicity

(Shelton et al. 2019)

What we discovered was:

- S. *jonesii* indigenous across all geographical regions and ruminant spp, regardless of consumption of leucaena.
- S. *jonesii* present in low populations, too low to degrade high leucaena diets.
- In Thailand, Indonesia, Mexico, goats / cattle consuming **100%** leucaena had very high levels of DHP in urine.
- DHP not degraded by *S. jonesii* , but animals were healthy and gaining weight.
- DHP was neutralized (conjugated) by compounds produced in liver and excreted in urine.



Urine samples showing undegraded DHP

Our new hypothesis: Inoculation may not be necessary

3.7 Environment issues

(Campbell et al. 2019; Tomkins et al. 2019)

Negative issues

Weediness

If not managed, long-lived seed spreads between rows, and outside to roadsides & water courses.

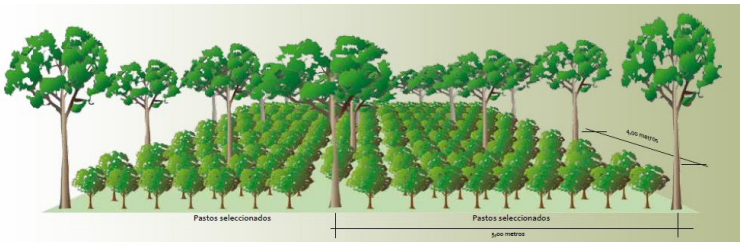
Options available:

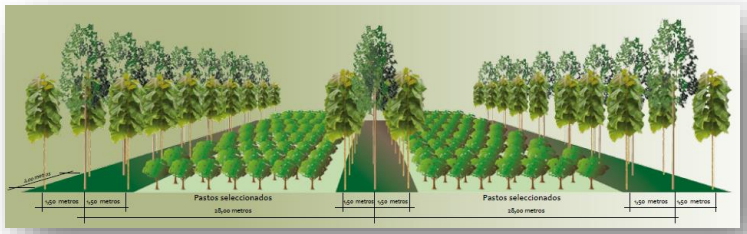
- In Australia, Code of Practice promotes management to control unwanted plants
- Greater involvement with government and environmental agencies to negotiate planting permits.
- A new suite of herbicides available
- Sterile leucaena variety under development

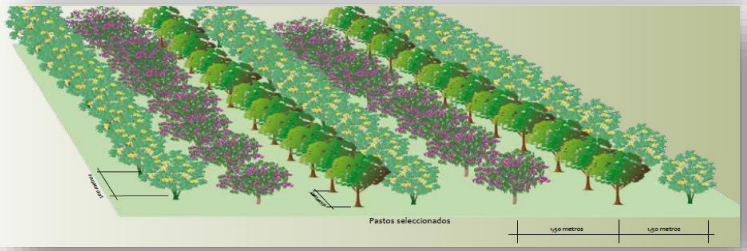
Positive issues

- Long term sustainability
- Soil improvement (N & OC)
- Erosion & water quality control
- Improved animal welfare
- Reduced methane emissions, and opportunities for C credits
- Organic beef production
- Biofuel for renewable power generation

3.7 Environmental issues
Intensive Silvo-Pastoral Systems – iSSP (Chara et al. 2019)







Source: Murgueitio et al. 2016

Photo: N. Pachas (Colombia)

Good for biodiversity of
birds and insects
C sequestration

3.8 Adoption

HOWEVER!

General agreement at conference - despite overwhelming evidence for high productivity, profitability and sustainability of leucaena feeding, adoption was universally below expectations.

In Australia, small % of potential land area planted to leucaena.

Delegates suggestions:

- More field days and training courses with on-farm demonstrations.
- Greater effort to engage environmentalists, catchment management groups, green-leaning city folk, all sectors of government.
- Public relations exercise to tell great story of profit and sustainability, environmental benefits, and strategies to minimise weediness e.g. sterile leucaena program.

Adoption of Tarramba leucaena for cattle fattening in Indonesia (2011-2016)

Adoption barriers and limitations can be overcome:

1. Meet and engage with farmer needs
2. Technical constraints solved
3. Good project leadership and staffing
4. Socio-economic and agribusiness relevance
5. Government policy and involvement

4. Future strategies and priorities

- Huge potential to expand the area of leucaena pastures around the world
- Focus on adoption as major limitation
- Develop international collaborations
  - Delegates suggested collaborative international research agenda
  - Continuing international meetings. Indonesian team offered to host next conference.

Some continuing R&D priorities

- **Adoption** – Much greater effort needed
- **Leucaena toxicity** – need confirm conjugation of DHP occurs other countries, other ruminant spp.
- **Anthelmintic properties** (for ruminants, non-ruminants, humans)

Thank you