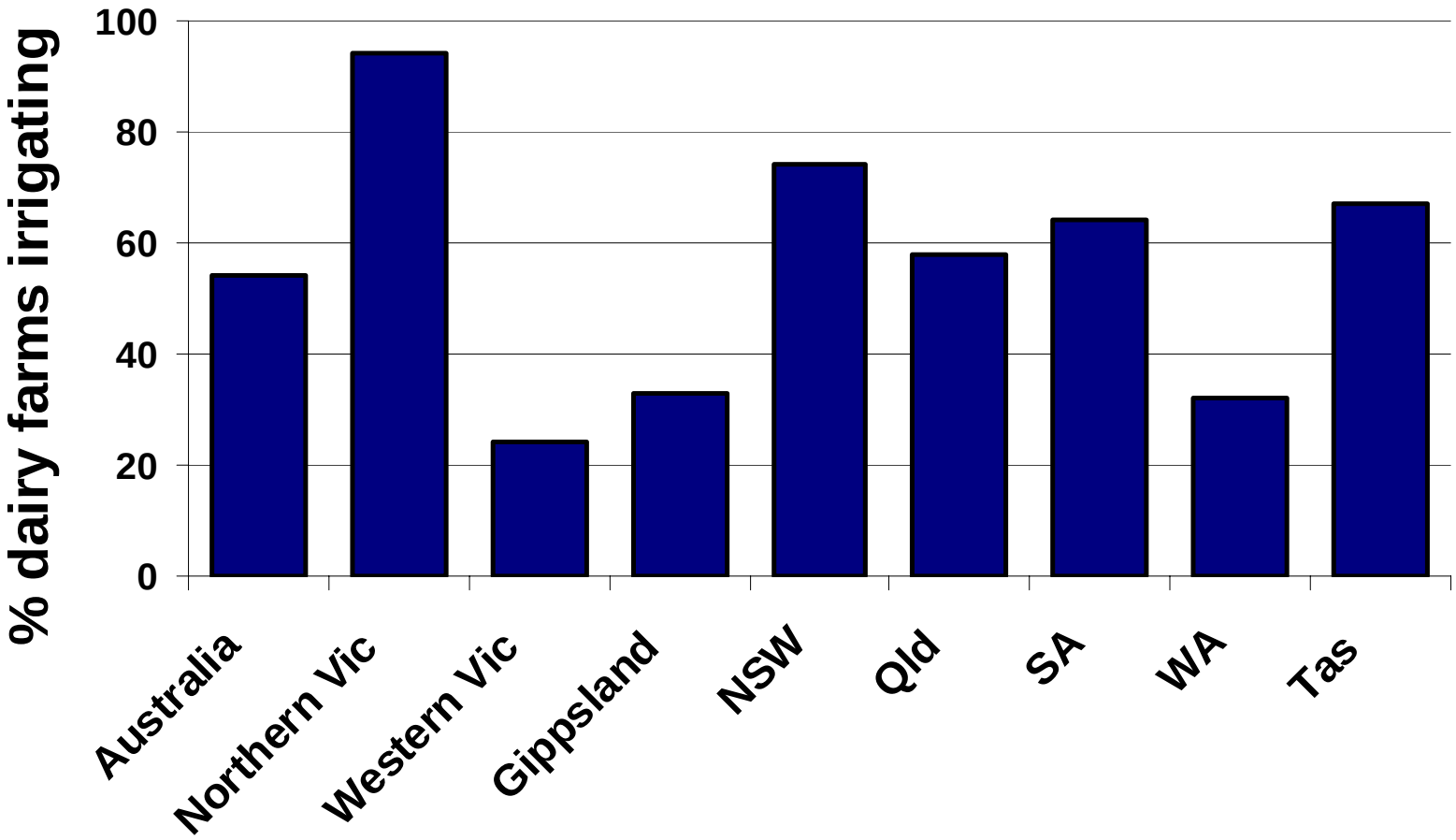
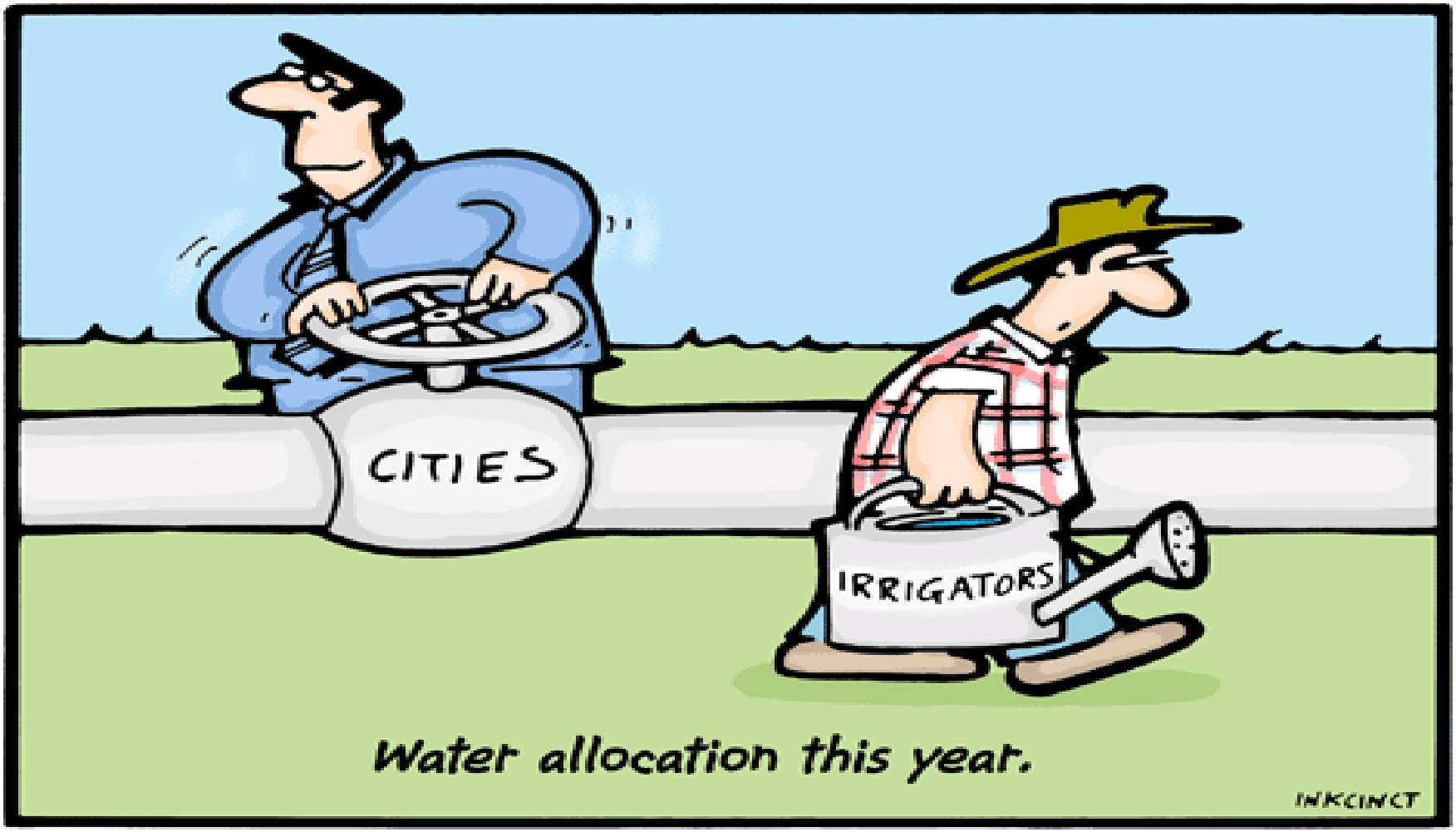
NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Why is forage water use efficiency important for the Dairy Industry?

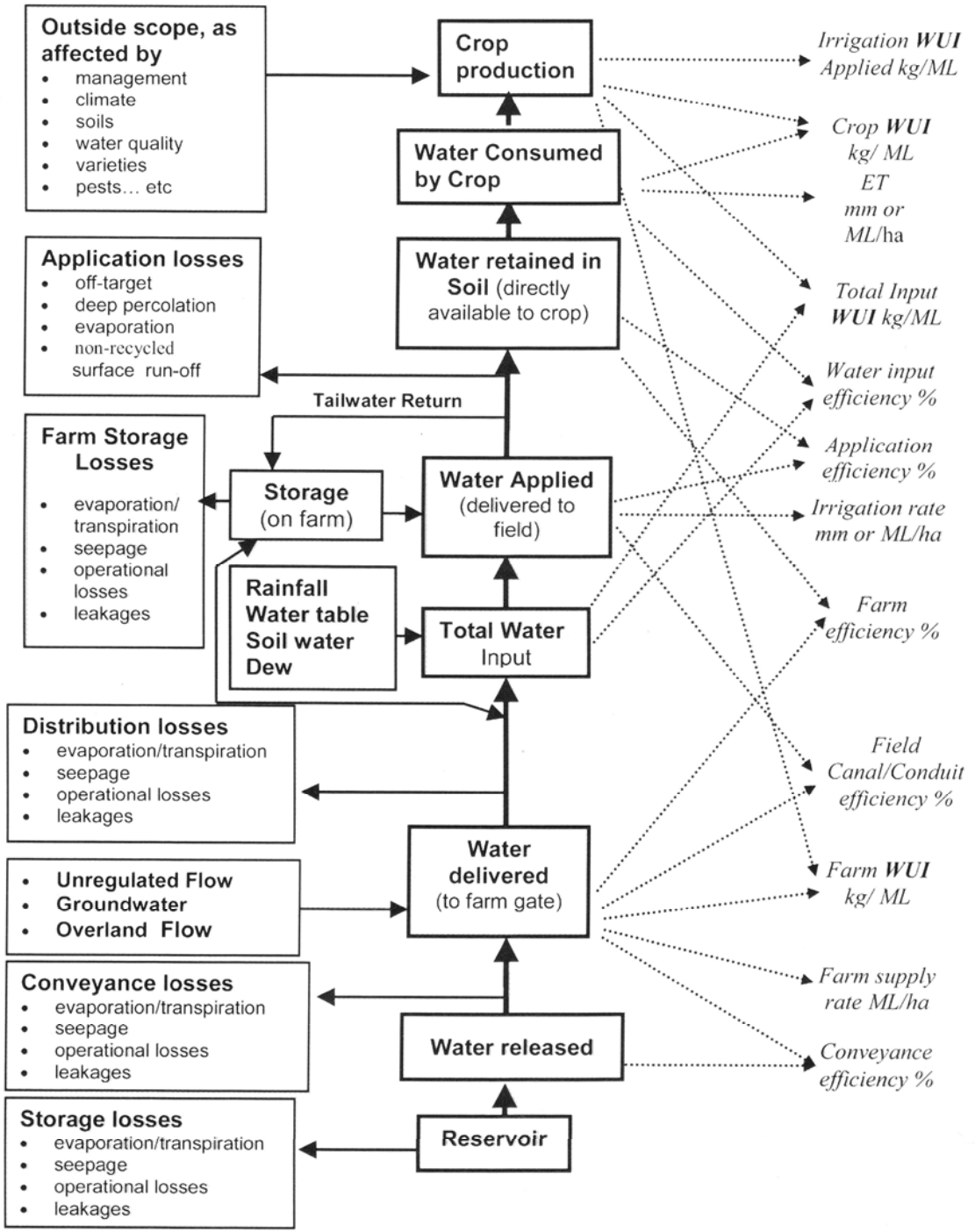
Water Use Australia



Water scarcity & pricing



Water Use Efficiency Indices



Forage Water use index

- **Forage water use index = $\frac{\text{Forage yield (kg DM)}}{\text{Water used (mm)}}$**

water used (mm) = (rainfall + irrigation
+ change in soil water content
– runoff – drainage)

Forage species evaluated...

Temperate Perennial Grasses
Perennial ryegrass
Cocksfoot
Fescue
Prairie grass
Phalaris
Temperate Annual grasses
Annual ryegrass
Triticale
Wheat
Oats

Summer C_4 crops
Maize
Sorghum
Millet
Tropical C_4 grasses
Kikuyu
Paspalum

Perennial Herbs
Chicory
Plantain
Annual herbs
Rape
Fodder radish

Perennial Pasture Legumes
White &
Red clover
Lucerne
Sulla
Birdsfoot
Annual Pasture Legumes
Balansa
Persian
Berseem &
Sub clover
Legume Crops
Maple pea
Lab Lab
Cow peas

Design

30 Species x 3 irrigation treatments

Optimum Irrigation **100%** **(Ideal conditions)**

30-40mm refill

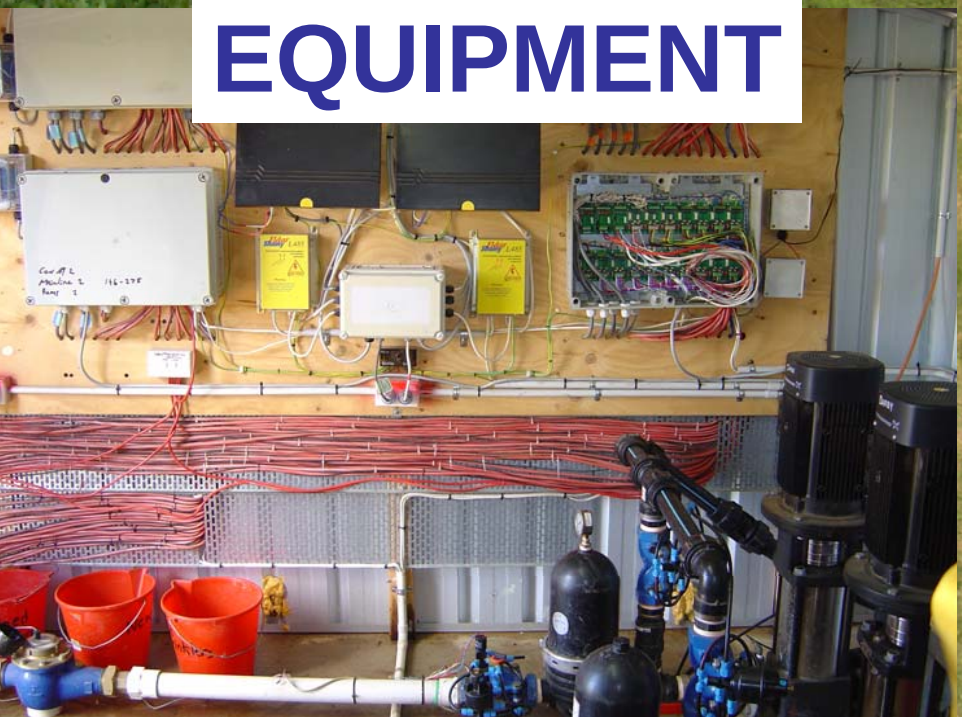
Deficit irrigation **33%** **66%** **(Tolerance to water stress)**

Harvested at specific stages for each forage

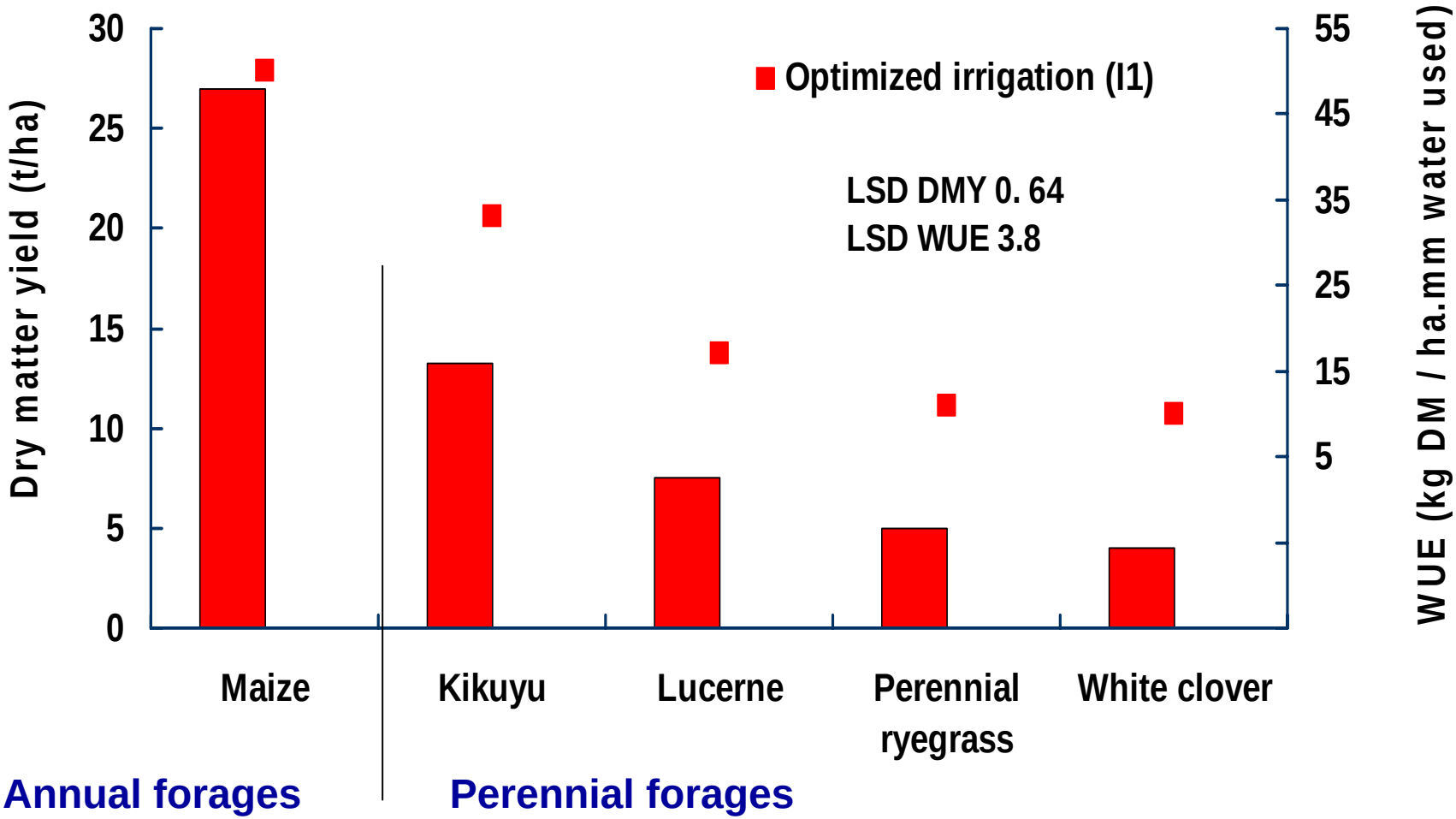
Fertiliser applied non-limiting plant growth

PLOTS

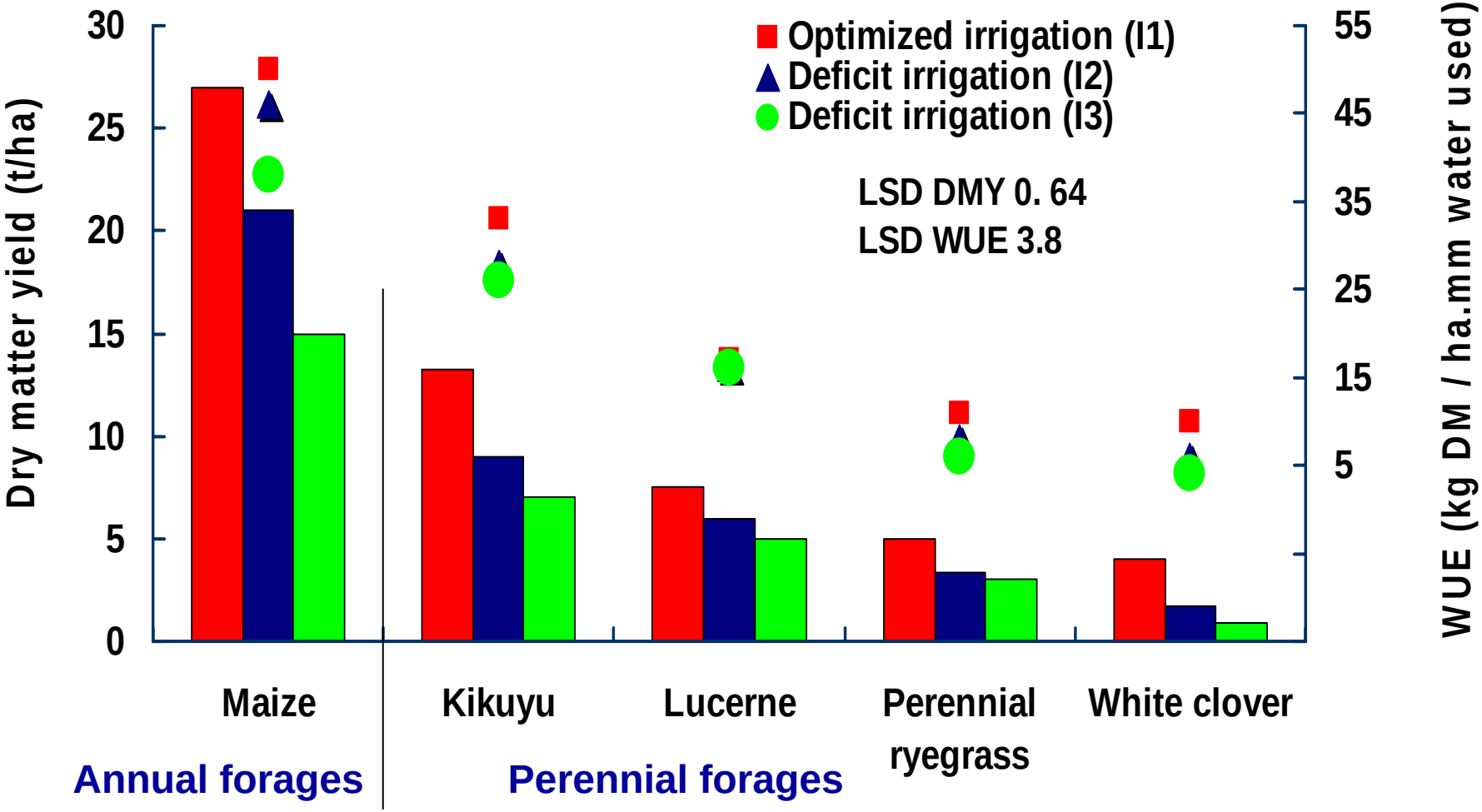
EQUIPMENT



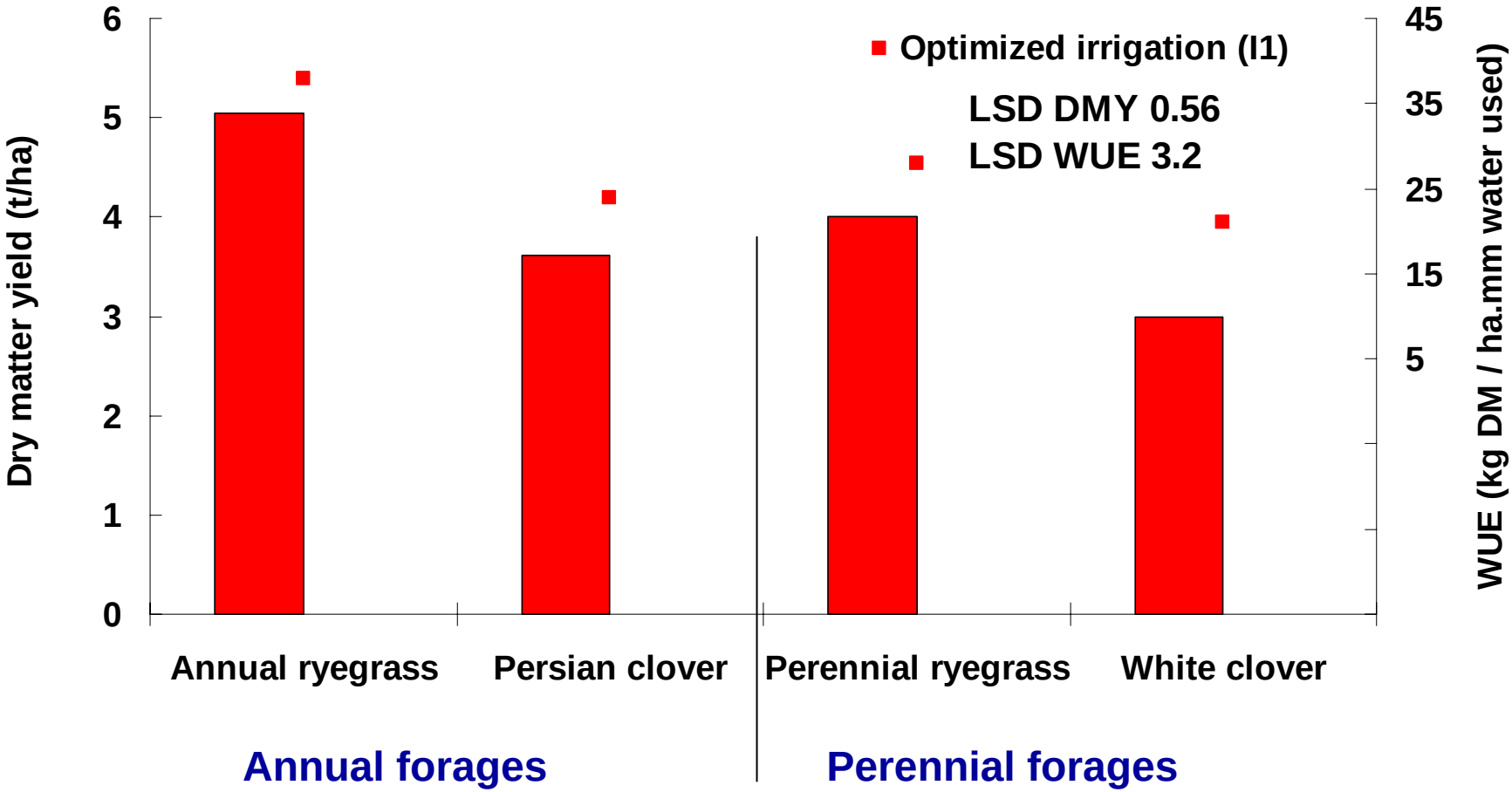
Example. response in summer



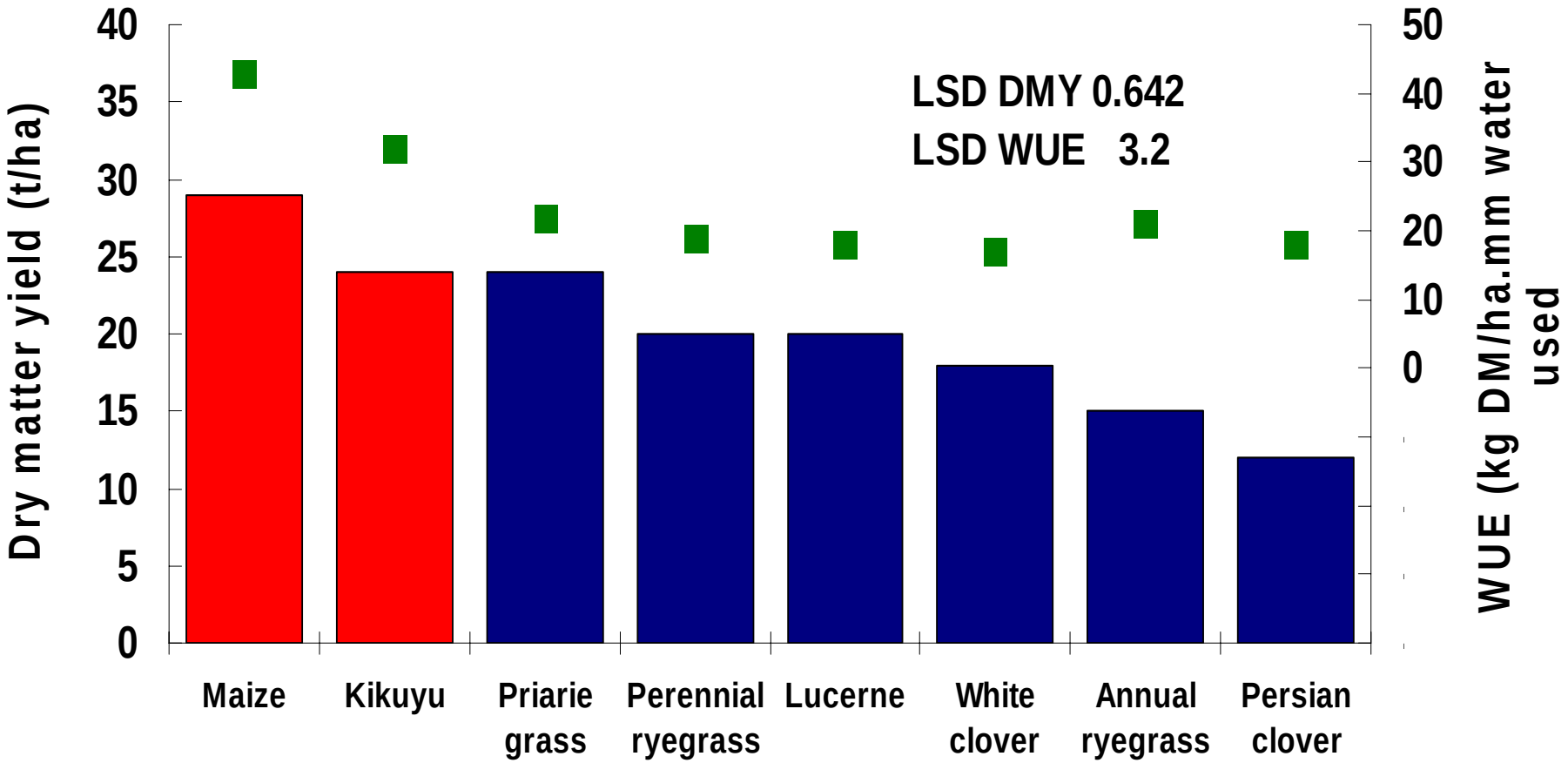
Example. response in summer- deficits



Example. response in winter



Example Yield and WUE entire year



Potential vs on farm yield and WUE

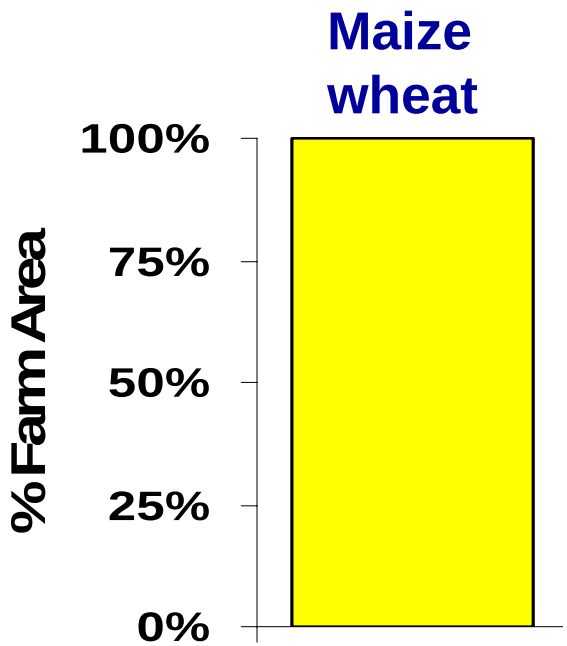
	POTENTIAL		AVERAGE ON FARM	
	Yields t/ha	WUE t/ML	Yields t/ha	WUE t/ML
Irrigated perennial Pasture	24	2.2	8	0.7
Maize	29	4.3	20	3.1

Whole-farm model

- **200 Hectare (500 acre) farm ($4.6m)**
- **Appropriate management - Full irrigation, fertiliser,**
- **Full range of supplements**
- **Cow production typical Australia herd**
- **Diet balanced**
  - **Metabolisable Energy (MJ)**
  - **Protein (%)**
  - **Fibre (%)**

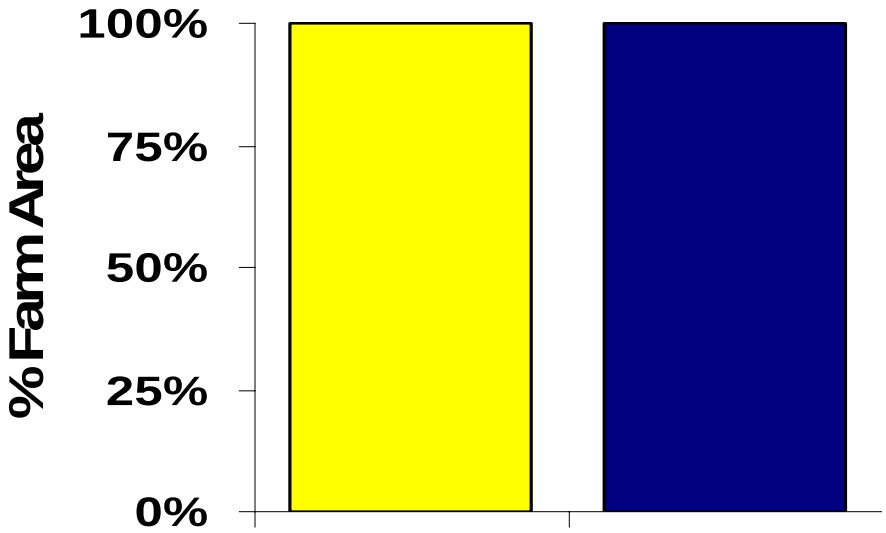
Maximum Yield

Profit (EBIT) $- 202,000



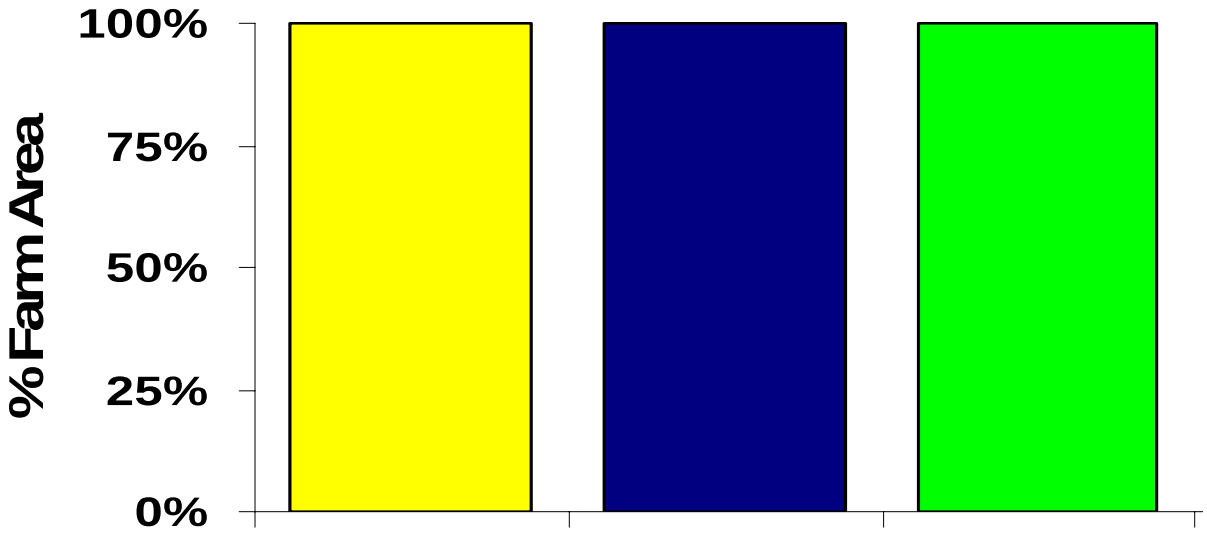
Neal *et al.* 2007 Journal Dairy Science

Maximum Yield	Maximum WUE
Profit (EBIT)	$ -202,000	**$- 489,000**
	Maize Wheat	**Maize**



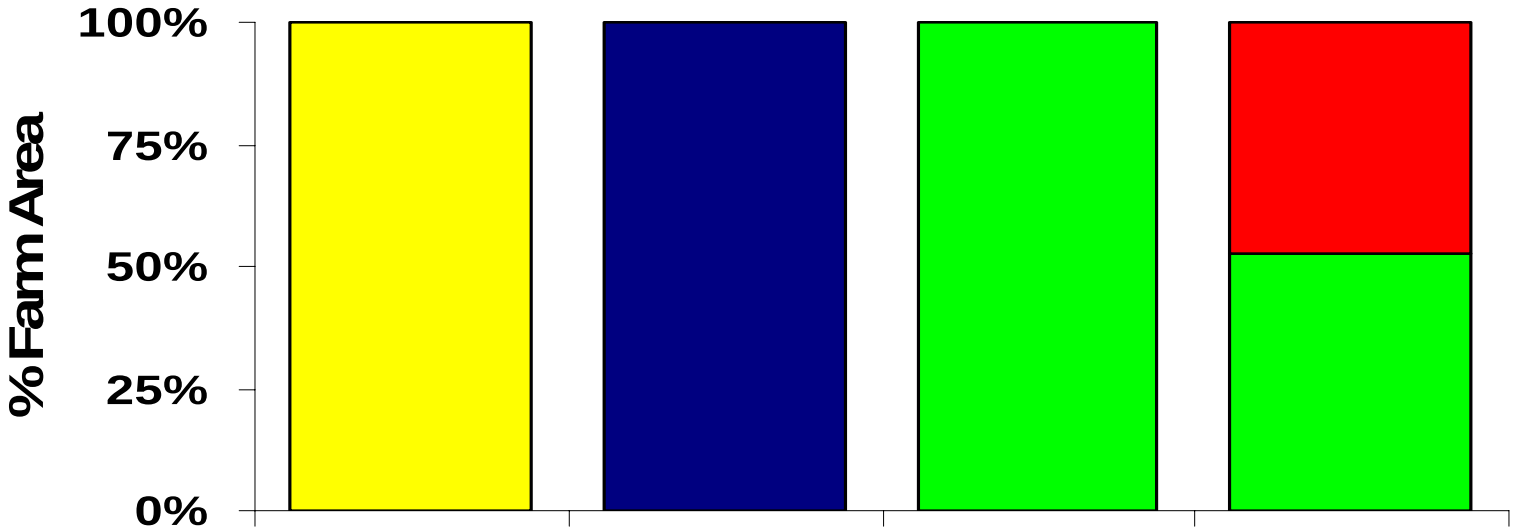
Neal *et al.* 2007 Journal Dairy Science

	Maximum Yield	Maximum WUE	Maximum Energy density
Profit (EBIT)	$ -202,000	$-489,000	**$214,000**
	Maize Wheat	Maize	**Perennial ryegrass**



Neal *et al.* 2007 Journal Dairy Science

Maximum Yield	Maximum WUE	Maximum energy density	**Maximum profit**
Profit (EBIT)	$ -202,000	$-489,000	$214,000	**$291,000**
	Maize/ Wheat	Maize	Perennial ryegrass	**Perennial ryegrass/ Prairie grass**



Neal *et al.* 2007 Journal Dairy Science

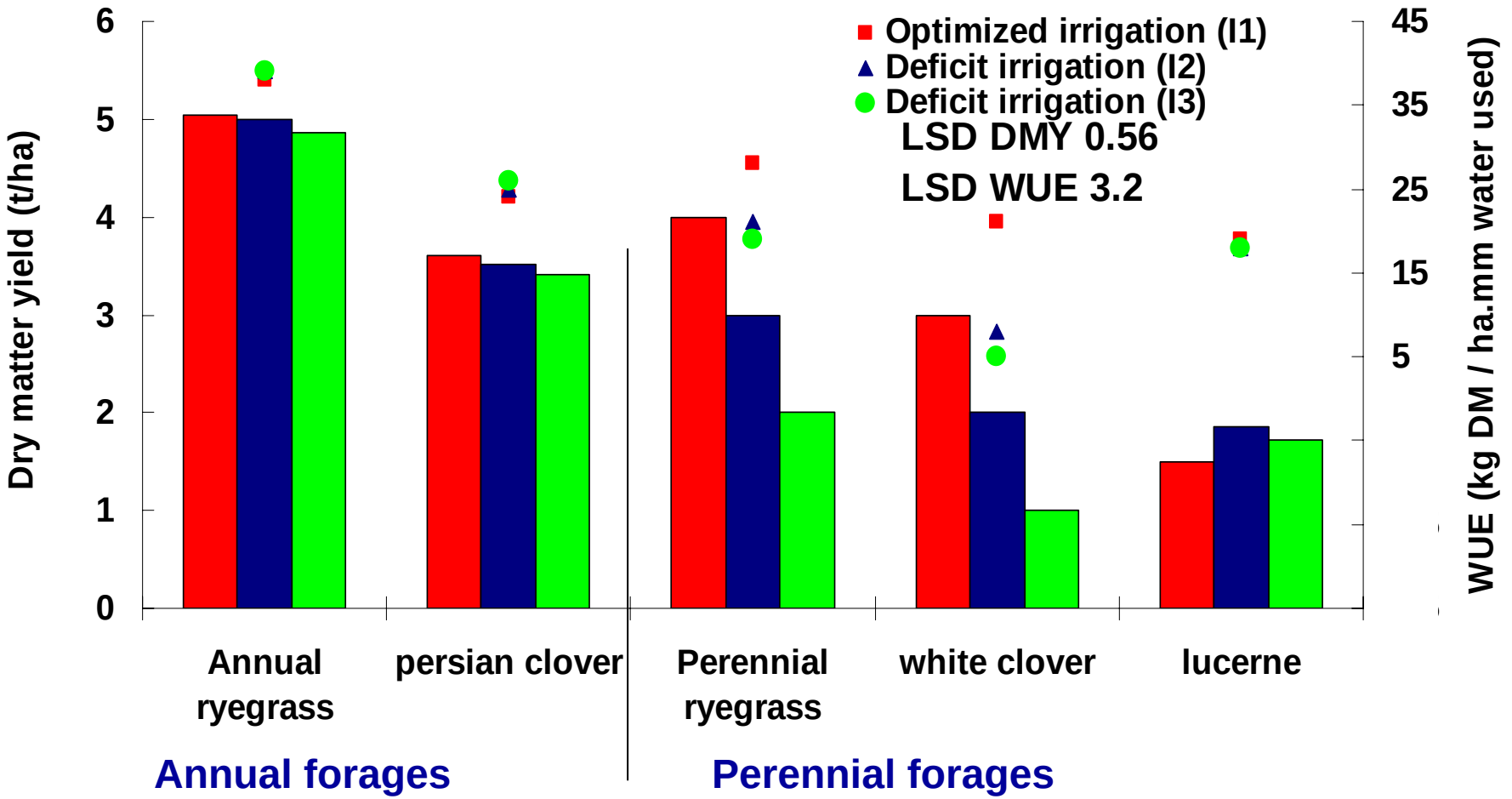
Take home message

- $Dairy farming is complex
- $Variation in WUE between forages
- $There is a tradeoff, between yield, WUE, nutrients and economics
- $Most productive or water use efficient ≠ most profitable
- $Higher WUE and yields are possible → removing limitations
- $Increase dairy production
- $More modeling and economic analysis need to be done

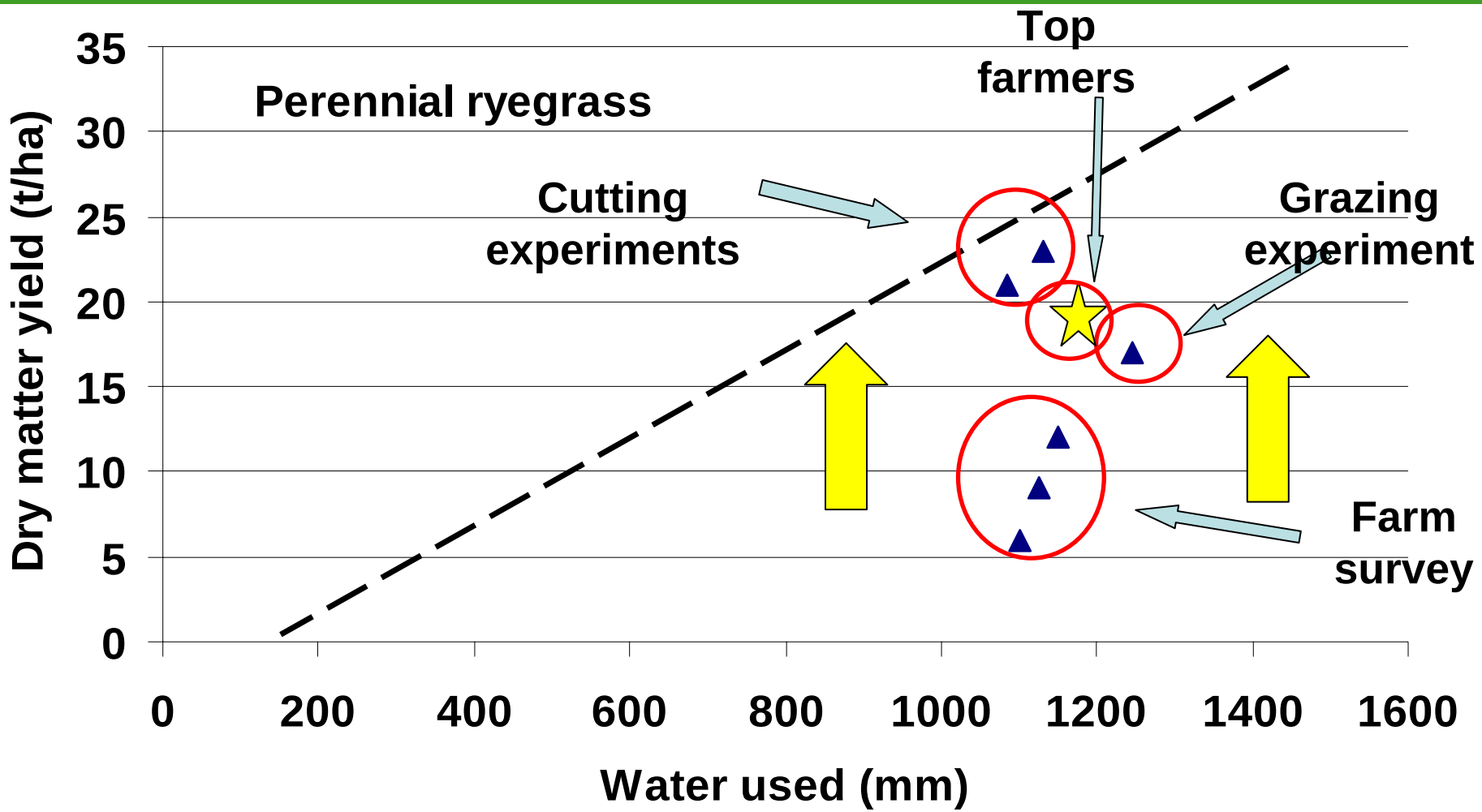
Questions

Future water security?

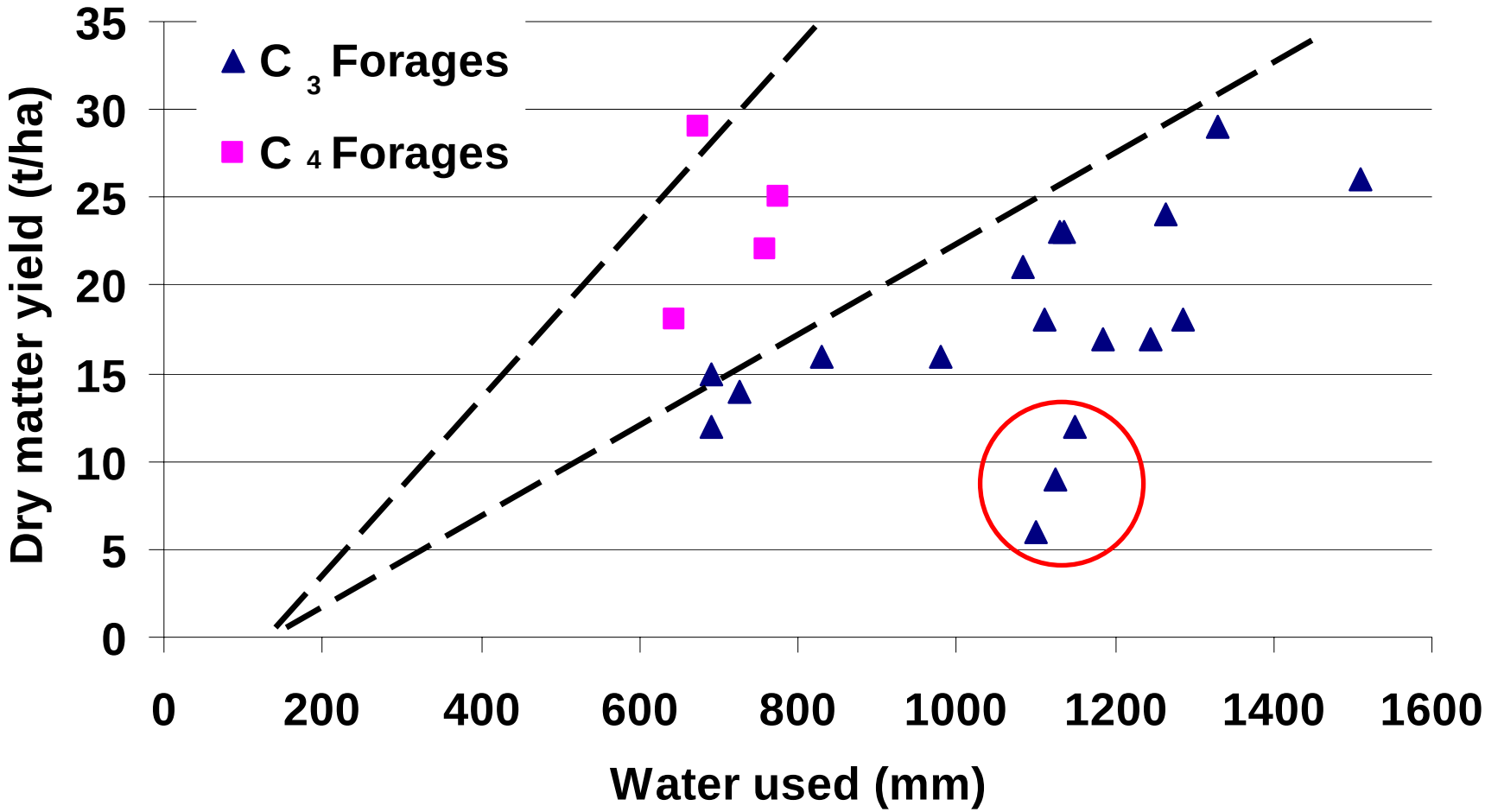
Example. response in winter



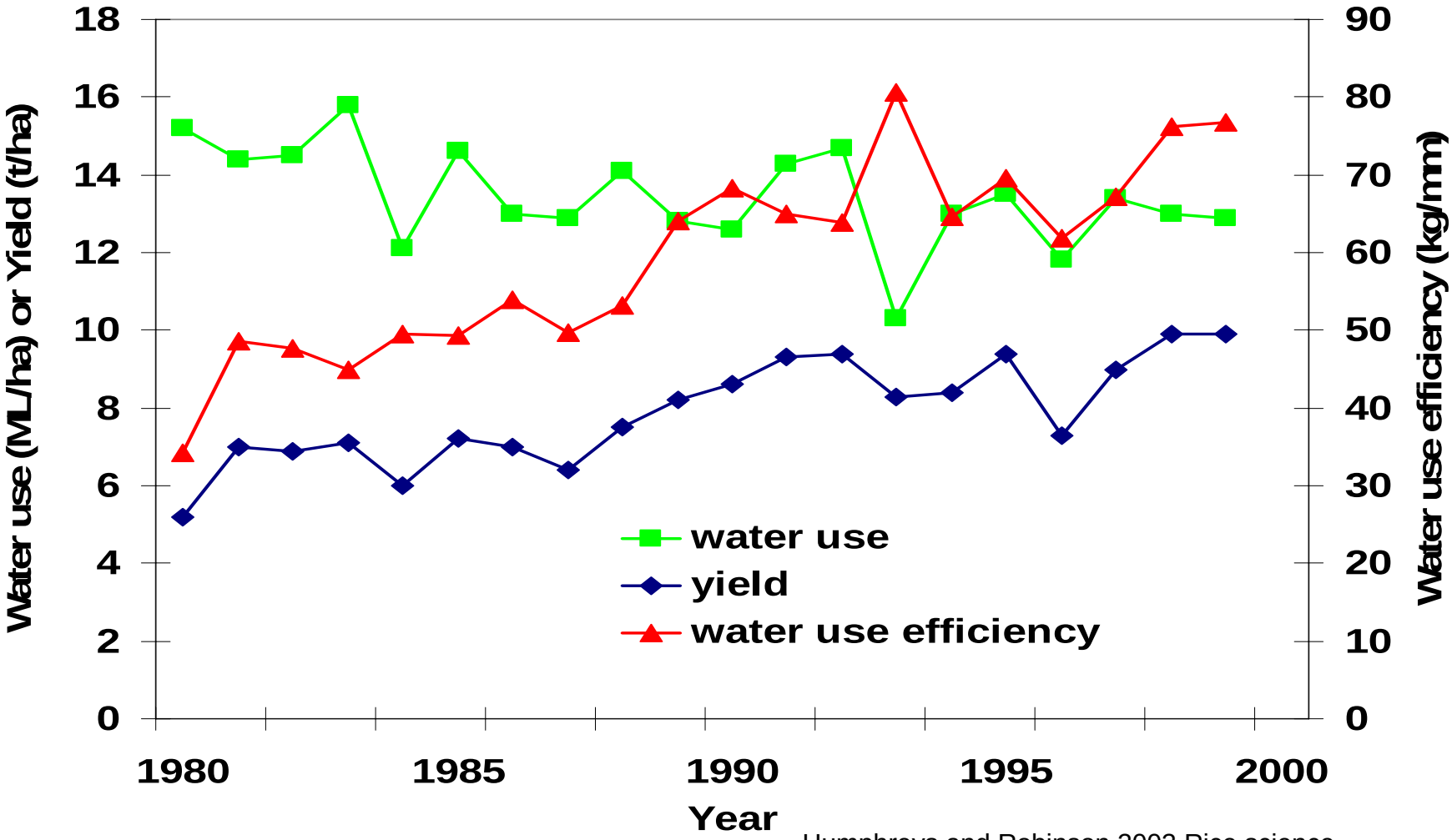
Perennial ryegrass



Potential water use efficiency



Water use efficiency change over time



Humphreys and Robinson 2003 Rice science

Soil water extraction