



# Surface Irrigation for Energy and Water Use Efficiency

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fulfilling lives



## Premise

Surface irrigation (bay and furrow) with automation and real-time optimization:

- can give application efficiencies equivalent to pressurised systems;
- uses much less energy per unit of water than pressurised systems; and
- should be the preferred system for the majority of our broad acre crops, fodder and pasture.

# Where have we come from ?

## Previous performance of surface irrigation

# Sugar (Qld) 1994/95

- Burdekin region - 52 irrigations
- Application efficiencies 14 to 90%
- Average efficiencies
  - Cracking clay 62%
  - Alluvial & Non-sodic duplex 35%



## Cotton (late 1990's)

Average application efficiencies for furrow irrigation less than 50% (range 17 to 98%)- over 300 evaluations

## Ord (sugar) early 2000's

- 30 irrigations, cracking clay soil
- average application efficiency 61% (range 36 to 81%)



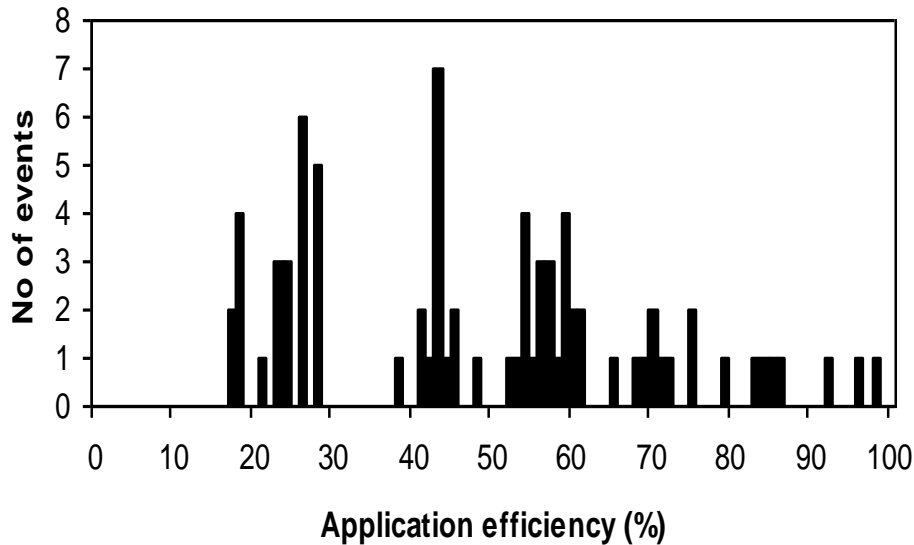
## Bay irrigated pasture (Vic) 2009

- 7 soil types, 9 irrigations
- average application efficiency 69% (46 to 86%)

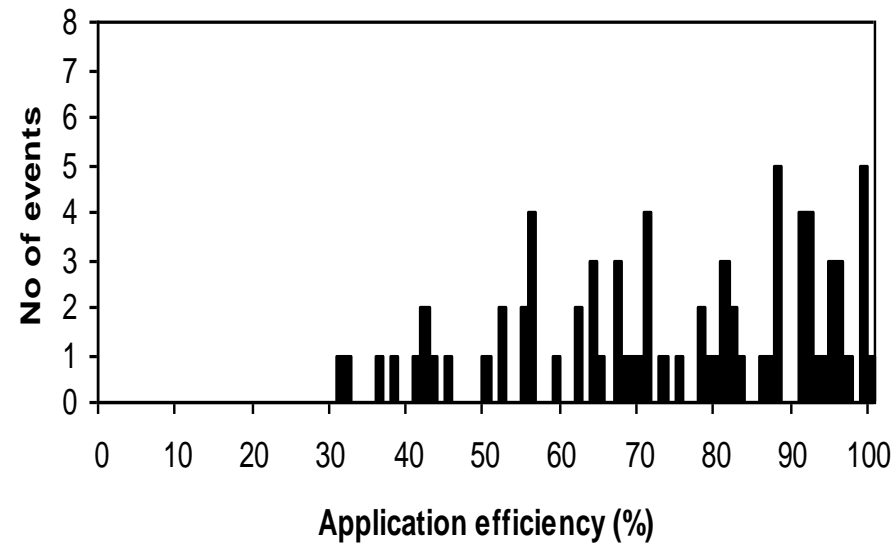


# Where do simple improvements take us ?

# Performance improvement – Surface irrigated cotton



**Farmer management**  
– average efficiency 48%

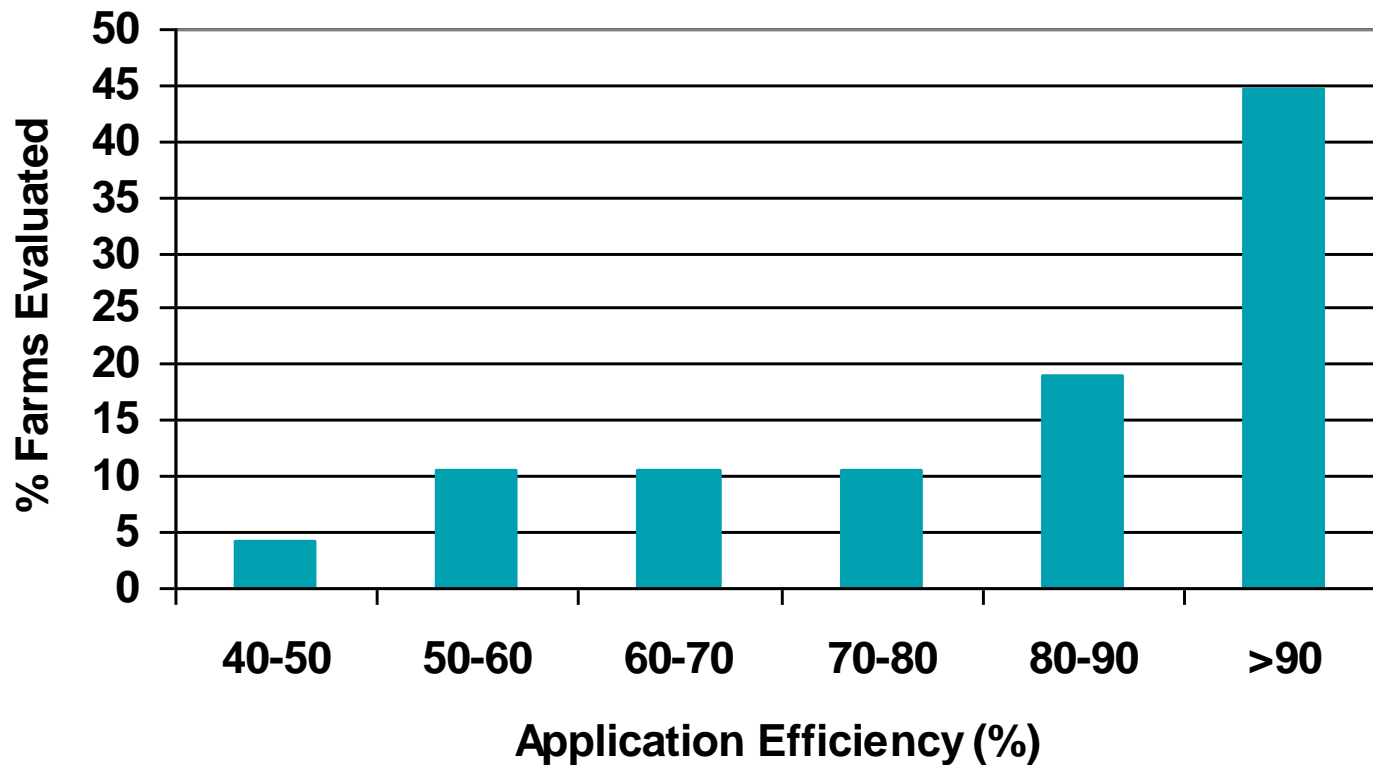


**Flow rate 6 l/s cut off at 90%**  
**of advance time**  
– average efficiency 74%

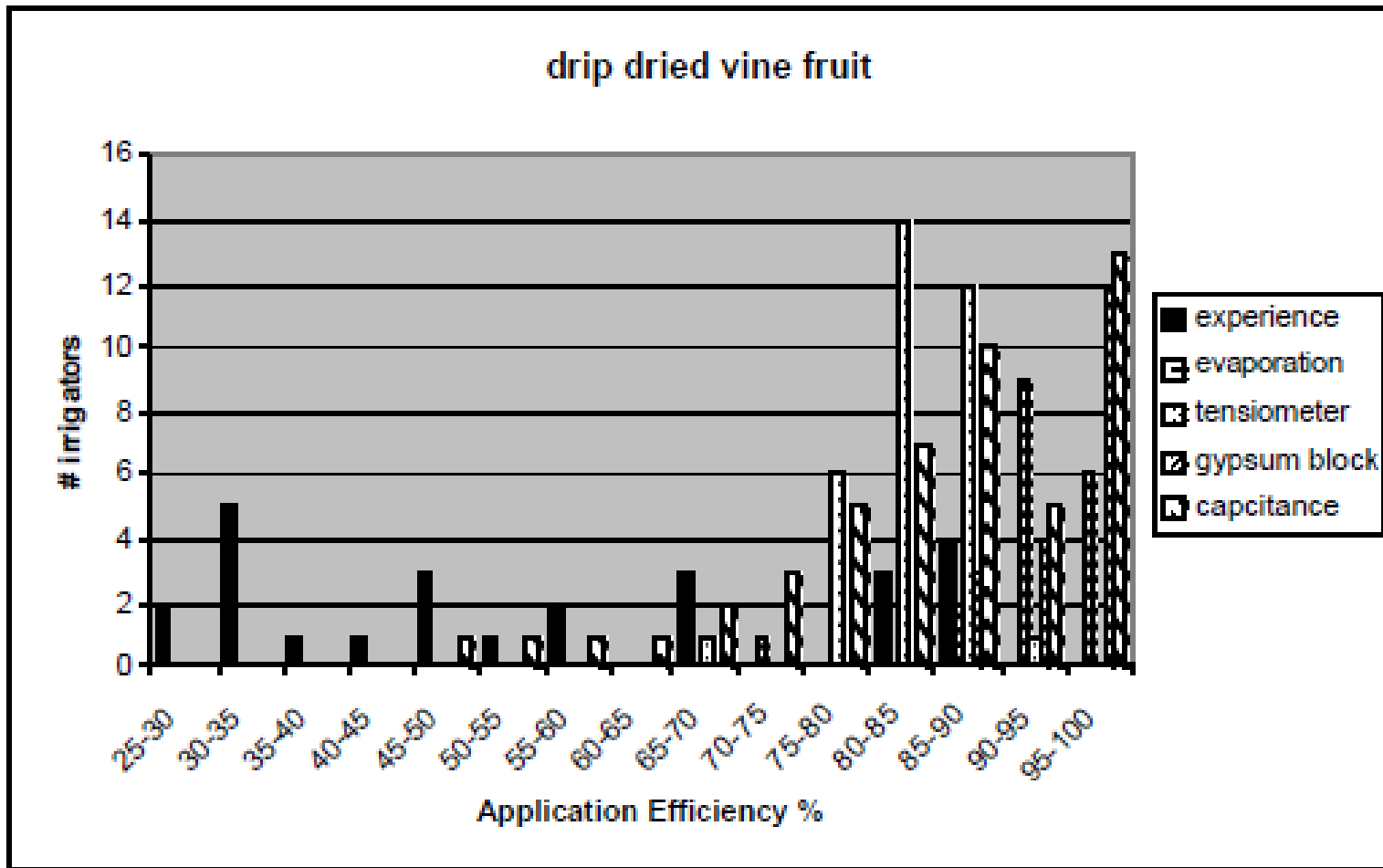
# Furrow evaluations 2007 (Cotton)

(Montgomery & Wigginton)

47 irrigations on 9 farms







## Application efficiencies for drip irrigation of dried vine fruit (Schrache, 2011)

# What can we achieve with advanced technology ?

**Application efficiencies in excess of 85%  
are possible NOW using high flow rates  
and real-time optimisation**



**e.g. High flow-rate bay irrigation trials (Vic) 2010**  
**5 soil types, 5 irrigations**  
**Application efficiency 90% (82 to 95%)**

**Automation hardware and software for bay irrigation is available, e.g., 'FarmConnect' system from Rubicon Water**



**NCEA has adaptive real-time optimisation based around the simulation model SISCO**

# Energy useage ?

## Jackson et al. (2010)

- Measured the energy consumption for irrigated cropping in two regions (surface water source and groundwater source)
- Estimated the energy cost of converting surface irrigation to pressurised (centre pivot or drip) based on arbitrary improvements in application efficiency

**However they did not include improved surface irrigation in the analysis**

## Energy consumption included:

- energy consumed during irrigation - which is entirely for pumping and is a direct function of the quantity pumped and the head (lift + pressure) added to the flow.

plus

- the energy used for other farm operations to give total energy use.

# Energy consumption for irrigation of a hypothetical grain crop from a surface water source



System	Water applied (ML/ha)	Water savings (ML/ha)	Energy use (MJ/ha)
Current surface irrigation ( $E_a$ 55%)	7.3		9700
Real-time optimised surface irrigation ( $E_a$ 85%)	4.7	2.6	9700
Centre-pivot irrigation ( $E_a$ 90%)	4.4	2.9	17000
Drip irrigation ( $E_a$ 95%)	4.2	3.1	16000





## Take home message

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