Department of Primary Industries

Irrigation 101
Design and management principles

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10 key principles of irrigation design and management

1. Have a Whole Farm Plan
2. Irrigation systems should suit soil types
3. Drainage is as important as supply
4. Use it to make it pay
5. Get your infrastructure right
6. Topsoil when landforming – min 7.5 cm
7. Surface irrigation design – *water on and off bays within 10-12 hours*
8. Sprinkler irrigation design – *pipe size for min pressure; have sufficient capacity*
9. Commission all works to check they are built and perform as designed
10. Match crop inputs (i.e. planned yield) to your water budget

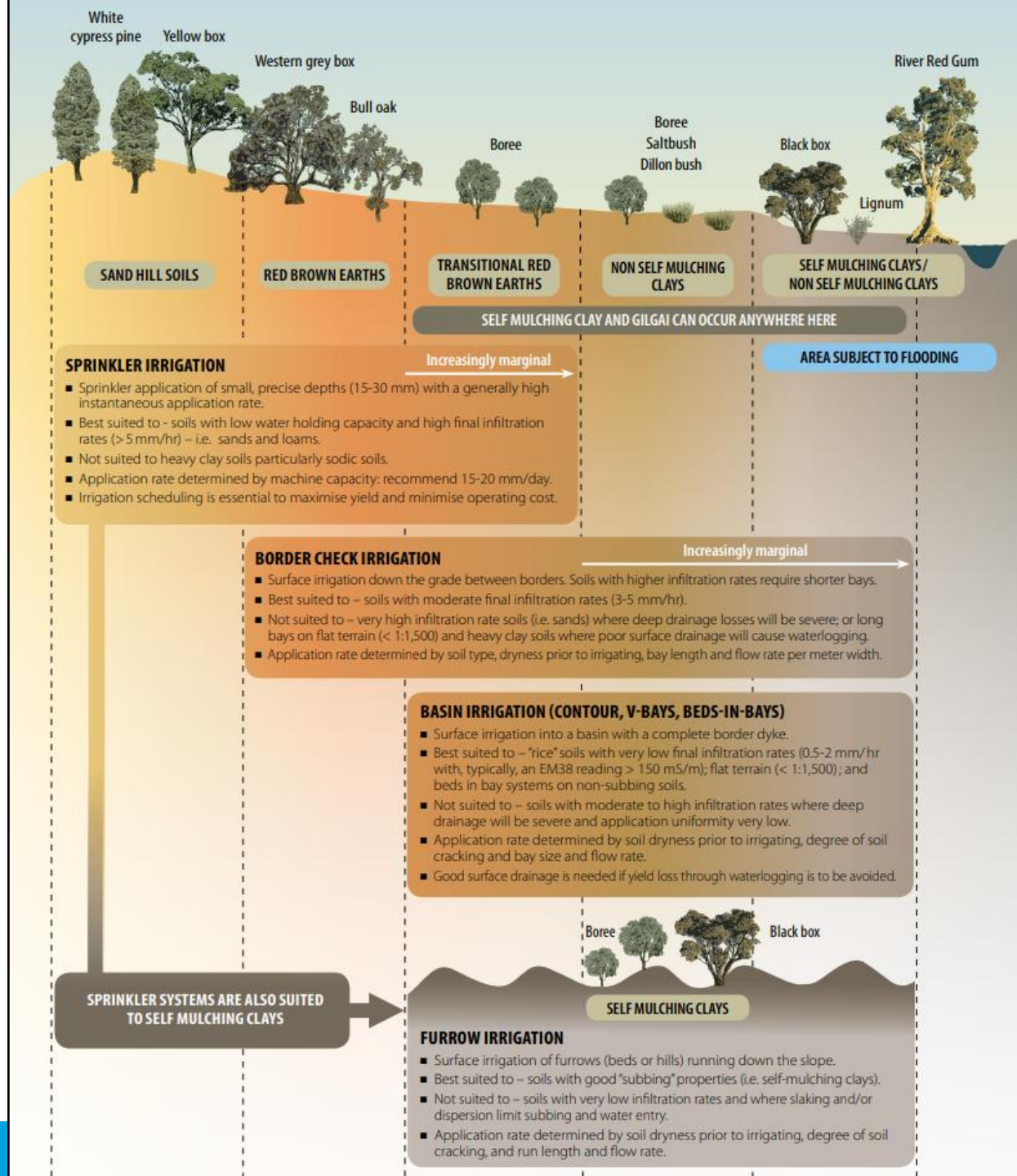
2. Systems should suit soils

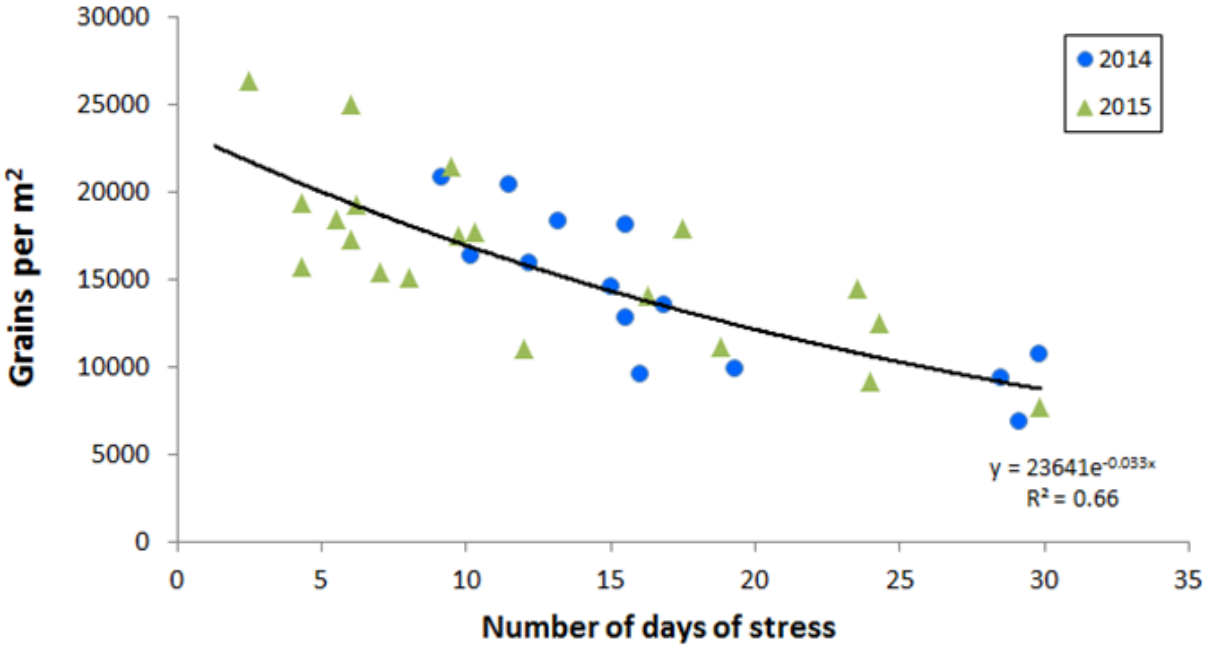
SAND **LOAM** **CLAY**

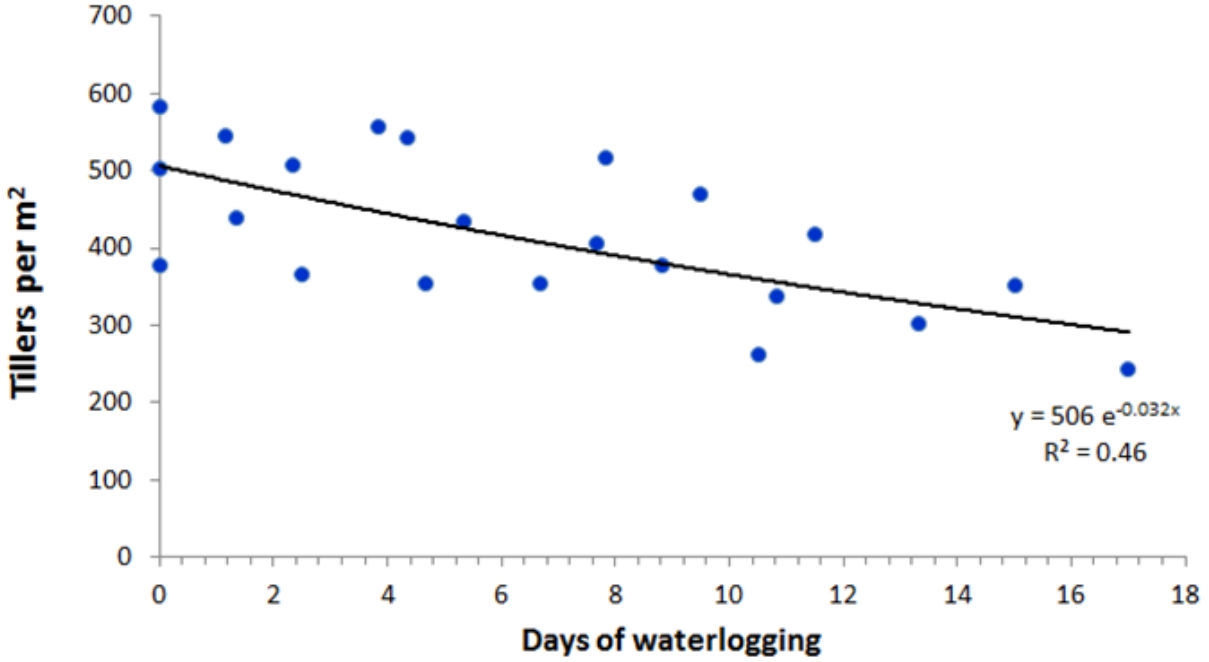
low → water holding capacity / ML/ha water per irrigation → high

high → infiltration rate / irrigation frequency → low

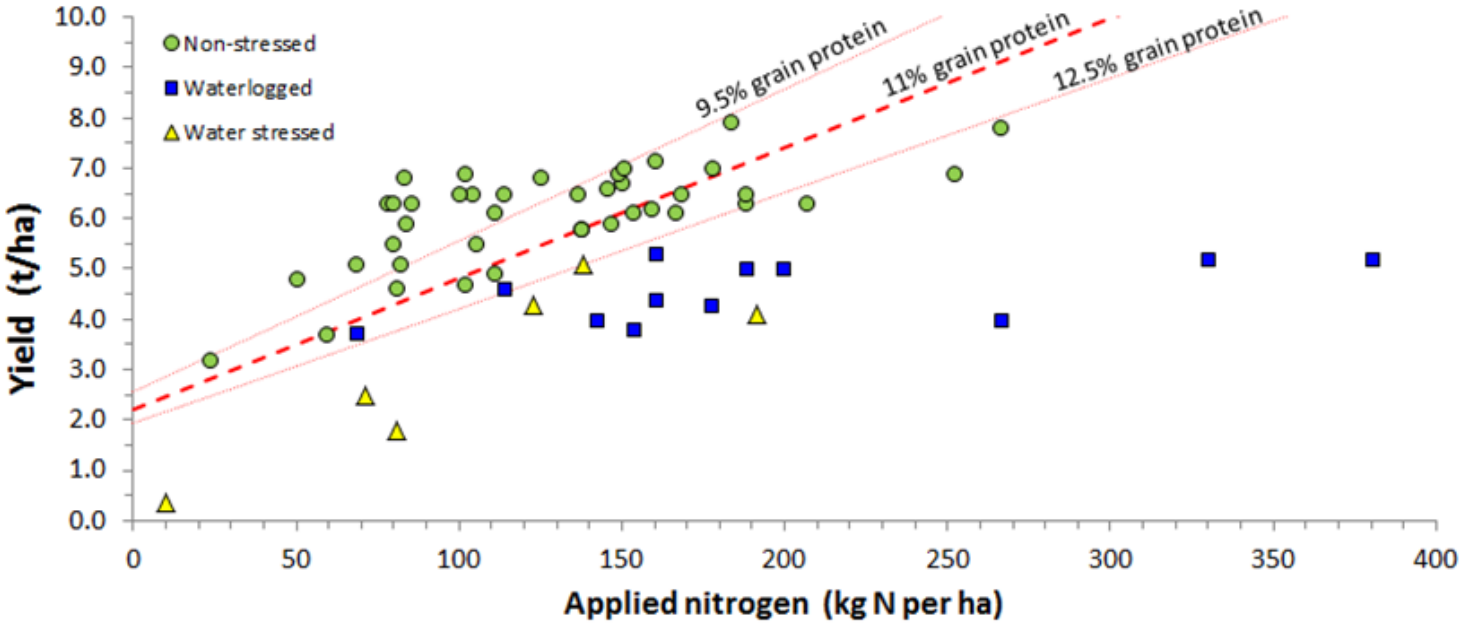
low → need for slope → high







3. Drainage is as important as supply



4. Use it

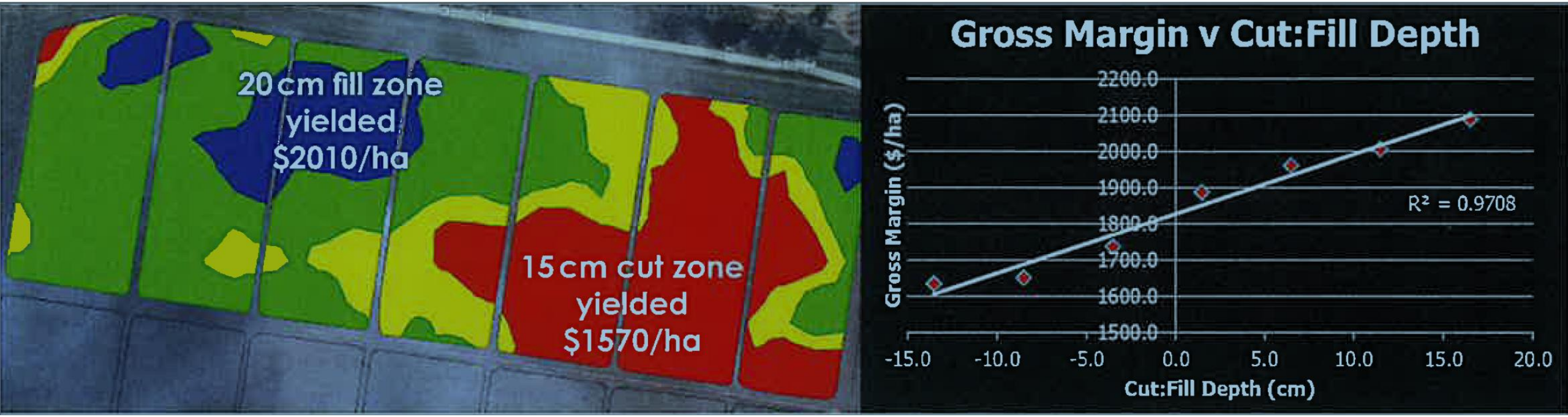
- Irrigation businesses are viable if total irrigation costs ≤ 25% of gross income (RMCG)
- Total irrigation costs = fixed costs + variable costs (per ML)

- Example 1
  - *600 DE = $12,000 p.a. at $15/DE + fixed charges*
  - *Usage charge = $15/ML*
  - *Use 100 ML, total irrigation cost = $12,000 + $1,500 = $135/ML*
  - *Use 600 ML, total irrigation cost = $12,000 + $15,000 = $35/ML*

- Example 2
  - *Capital cost make up more than 50% of annualised total cost of CPLM.*
  - *Total costs per ML will be reduced if capital costs are spread over more ha or more ML – use it*
  - *Cost:income ratio*
    - *winter cropping = 33%* *machine used only 50% of time*
    - *Summer & winter cropping = 25%* *machine used 2 years in every 3 – 66% of time*

6. Topsoil when land-forming

- Production losses in cut areas are long lasting and cannot be fixed by soil amelioration
- Avoid these long-term losses by topsoiling when land-forming
- Stockpile topsoil, under-cut, and re-spread top-soil to a min depth of 7.5 cm (3")



Effect of cut and fill on rice gross margins

Source: Precision Agriculture Pty Ltd (2016)

7. Surface irrigation

Get water on and off bays within 10-12 hours

Time on – flow rate per unit width of bay

- Bay size in ha should be no more than ¼ flow rate in ML/day

Time off – slope, run length, friction

- Min slope = 1:2000; min 300 mm fall out of bays
- Run length < 400 m
- Drill rows parallel to slope; clean furrows and drains

Side-ditch layouts

- flow rate = head loss

Layout type	Farm	Time to cut-off *(hrs)*	Time to drain *(hrs)*	Duration of ponding *(hrs)*
Border check	1	16 – 18	2	18 - 20
	2	19 – 23	2 – 3	22 - 25
	3	11 – 13	3 – 4	14 - 16
Beds in bays	4	6 – 11	15 – 20	26
	5	7 – 9	5 – 29	12 - 38
	6	10	40	**50**
V-bays	7	6	8 – 16	14 - 22
	8	25	20	**45**
	9	10 – 14	35 – 46+	**45 – 60+**
Contour	10	10 – 12	42 – 50	**54 – 60+**
	11	20	38	**58**
	12	18	30	**48**
	13	16 – 20	60 +	**80 +**
	14	30 – 40	10	**40 - 50**

8. Sprinkler irrigation design

Required system capacity

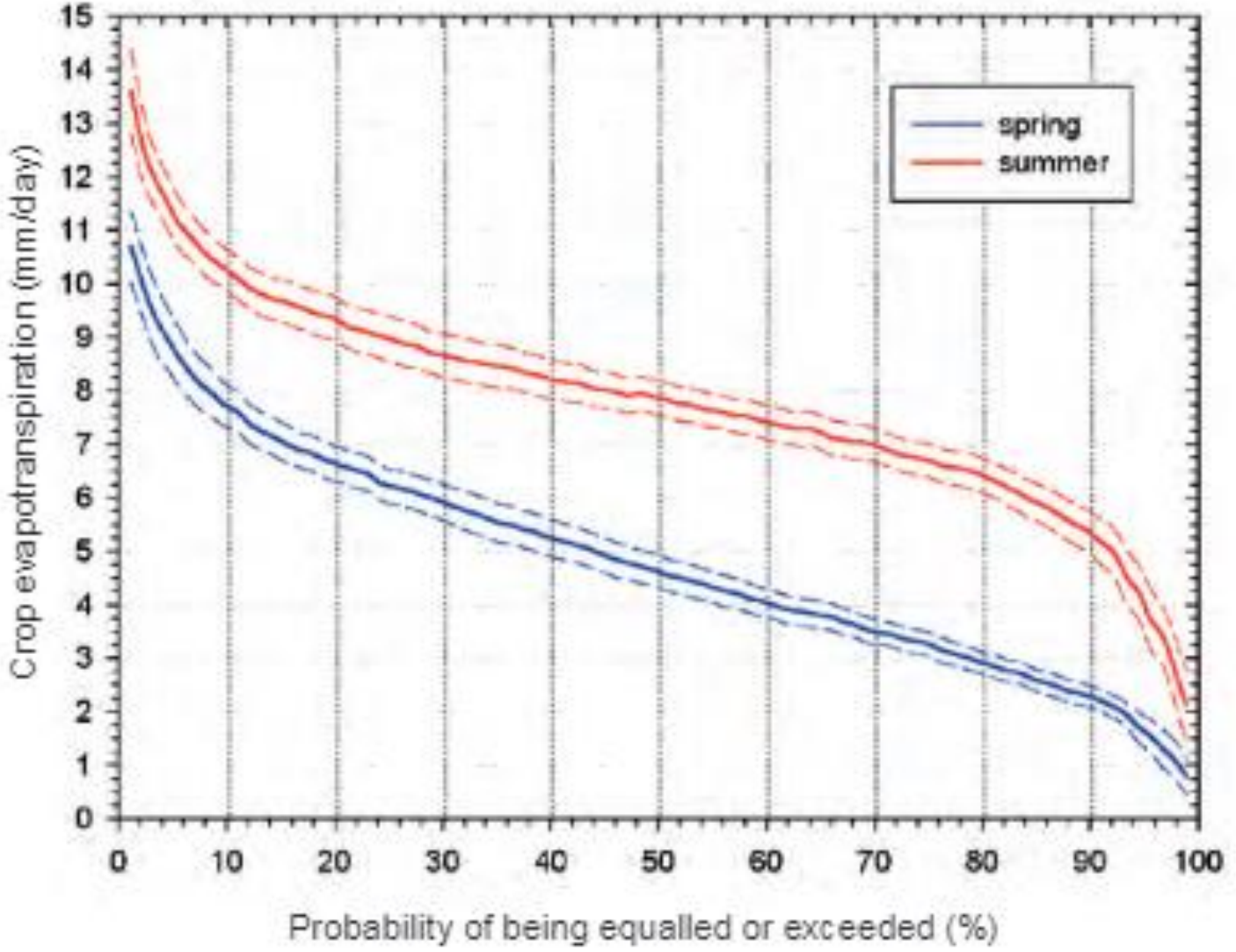
- Winter crops; towable pivot on two circles = 15 mm/day
- Lucerne; one circle = 17 mm/day

Actual system capacity

$$= \frac{pump\ flow\ rate}{area\ irrigated} \times AE \times PUR$$

AE = application efficiency (0.90-0.95)

PUR = pump utilisation ratio



10. Match crop inputs to a water budget

Physiological potential

- *6-12 t/ha potential, but max 8 t/ha in 50% years. Therefore, target max = 8t/ha*

Water budget

- *20 kg grain per ha per mm water less 50-110 mm as soil E*

Nitrogen budget

- *40 kg N/ha/t of grain*

Sowing rate and row spacing

- *For high yielding irrigated crop (6-7 t/ha), keep row spacing < 20 cm*

Further reading

Extension AUS website – for all things irrigation: https://extensionaus.com.au/irrigatingag/home

- Irrigation design - https://extensionaus.com.au/irrigatingag/tag/irrigation-design/
- Enter "*whole farm plan*" into the search bar to find a range of good articles and sources of information

My ResearchGate site - https://www.researchgate.net/profile/Sam-North/research

- Matching irrigation systems to soil type on the Riverine Plains of the southern Murray-Darling Basin
- Key constraints to irrigated wheat yields in the southern Murray-Darling basin

- Surface irrigation
  - The effect of layouts soils and agronomy on yields of non-rice crops
  - Improving the Performance of Basin Irrigation Layouts in the Southern Murray-Darling Basin

- Sprinkler irrigation
  - Planning and Managing Centre Pivot and Linear Move Irrigation in the Southern Riverina
  - Performance of centre pivot and linear move irrigators