IMPROVING IRRIGATION Efficiency

Principles and Practices

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There are **three essential principles** to increasing water use efficiency-

- Understanding available soil water (ASW)
- Timing and duration of irrigation according to ASW
- Training plants to the irrigation regime.

1. “Available” Soil Water (ASW)

- Definition: The amount of water held by a soil between “field capacity” and “permanent wilting point”
- Field Capacity (FC): The soil water content 48 hours after drainage from saturation
- Permanent Wilt Point (PWP): The soil water content below which plants cannot extract water.

Table 1. Available Soil Water in some common soil textures

Soil Texture	FC % v/v	PWP %v/v	ASW %v/v (mm/m)
Medium Sand	10	3	7 (70)
Fine or Loamy Sand	15	5	10 (100)
USGA Loamy Sand	18	4	14 (140)
Loam	30	12	18 (180)
Organic Loam	40	15	25 (250)
Clay Loam	35	18	17 (170)
Clay	40	25	15 (150)
Organic Structured Clay	50	30	20 (200)
Polymer Treated Sand (0.6%w/w)	35	15	20 (200)

Conclusion:

- Sandy Rootzone Soils usually hold around 15% or **150mm/m** of ASW.
- The heavier loams of fairways and soil based sports fields hold around **180 mm/m**.

Table 2. Relevant Irrigation Depths for a 300mm root zone

Irrigation depth for 300mm of-	To bring from PWP to FC	To bring from ½ PWP to FC
Fine sandy loam or USGA type sand	45 mm	22.5 mm
Heavier sandy loams	54 mm	27 mm

An average figure of around 25mm/300mm is a useful working figure.

Conclusion:

- Use the fact that soil is a “tank” or “reservoir” of water.
- For a Sandy Loam around 25mm of water will bring the soil from “half PWP” to FC and penetrate to 300mm

2. Timing and duration of irrigation according to ASW

- Irrigation Rule No 1.
- Make irrigations as deep and infrequent as possible to maximise rooting depth and plant use efficiency (evapotranspiration).

Do not use shallow frequent irrigation it encourages-

- Shallow rooting
- Irrigation “dependency”
- Poor drought tolerant
- Thatching
- Fungal Disease
- Increased evaporative losses
- Salt accumulation at the surface

Pan Evaporation

Class A Pan Evaporation

Potential Evaporation

} Evaporation loss from a free water surface

Evapotranspiration — The actual loss of water through vegetation (turf)

Evapotranspiration = Pan Evaporation x Crop Factor

Crop Factors for Warm Season Grasses-

Appearance and Growth	Crop Factor
Lush, Maximum growth Rates	0.6-0.8
Good Growth, acceptable appearance	0.4-0.6
Moderate Growth, just acceptable	0.25-0.4

EXAMPLE:

Pan Evaporation in Sydney January = 7.5 mm/day

Evapotranspiration for-

Maximum Growth 7.5 x 75% = 5.6 mm/day

Just acceptable (controlled stress) 7.5 x 45% = 3.4 mm/day

So: To apply our 25mm we would need to do this every-

Maximum Growth 25/5.6 = **4.5 days**

Just acceptable (controlled stress) 25/3.4 = **7.4 days**

Estimating Soil Moisture

- Soil looks dark and shiny, wet fingers - Above FC
- Soil looks dark and dull, not shiny and feels cool - FC
- Soil looks slightly dark and just feels cool to touch - ½ PWP
- Soil looks dry and does not feel cool to touch - PWP or drier

3. Training Plants to the Irrigation Regime

- Encourage deep root systems but using deep infrequent irrigations
- Do not use shallow frequent watering

Therefore

Examine root systems to make judgements about watering regimes-

Root Depth	Causes
No roots below 50-100mm	• Frequent shallow watering • Frequent excessive watering and waterlogging • Poor subsoil drainage an anaerobia at depth
Roots to 250mm	• Irrigation depth not quite adequate • frequent waterlogging and perched water table
Roots to 300-350mm	• Adequate irrigation depth and frequency • good drainage and no excessive use of perched water table.

Preparing for Drought and Restrictions

- Train the root system to maximum depth by using infrequent deep irrigation
- Get rid of cool season turf and use only warm season
- Start stressing plants by applying lower evapotranspiration factors (an acceptable appearance can be maintained as low as 0.3 or 30% of potential evaporation).
- Reduce nitrogen inputs and “harden” grass up by applying more iron and potassium.
- Eliminate fertiliser completely in full restrictions.
- Mow short, reduced leaf area reduces water loss.

Vegetation Demands – Is Turf the real culprit?

The CROP FACTOR for various vegetation types -

Vegetation Type and appearance	CROP FACTOR
Vigorous lush cool season grass	0.8
Cool season grass just acceptable	0.7
Lush warm season grass	0.7
Warm season grass just acceptable	0.3
Vigorous herbaceous broadleaves	0.8
Low growth drought tolerant natives	0.3
Desert Xerophytes	0.1

CONCLUSION:

- With managed irrigation in a manner appropriate to the conditions and with realistic expectations turfgrass can be a very water efficient vegetation type.
- Sportsturf managers will need to get used to less than perfectly lush grass to achieve this.
- This will not hurt warm season grasses which recover rapidly.