WATER AND ENERGY SAVING WITH DRIP IRRIGATION

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WHAT IS IRRIGATION?

Crop water loss

• Evaporation
  • From an open water surface
• Transpiration
  • Through the plant
WHAT IS IRRIGATION?

Evaporation (E)
WHAT IS IRRIGATION?

Transpiration (T)
WHAT IS IRRIGATION?

Evapotranspiration (ET)
TYPES OF IRRIGATION

Three broad types

Flood
Sprinkler
Micro
TYPES OF IRRIGATION

Flood
TYPES OF IRRIGATION

Sprinkler – Hand-move
TYPES OF IRRIGATION

Sprinkler – Side-roll
TYPES OF IRRIGATION

Sprinkler - Big Gun
TYPES OF IRRIGATION

Sprinkler - Big Gun - Travelling
TYPES OF IRRIGATION

Sprinkler - Centre Pivot
TYPES OF IRRIGATION

Sprinkler - Centre Pivot
TYPES OF IRRIGATION

Micro-irrigation – Micro-sprinkler
TYPES OF IRRIGATION

Micro-irrigation - Drip
POWER IN IRRIGATION

Combination of

• Flow rate
• Pressure
POWER IN IRRIGATION

Flow rate

• Volume of water over time
• Low
POWER IN IRRIGATION

Flow rate
• Volume of water over time
• High
POWER IN IRRIGATION

Pressure

• Force of water concentrated into an area
• Low
POWER IN IRRIGATION

Pressure

- Force of water concentrated into an area
- High
POWER IN IRRIGATION

Combination of

• Flow rate x Pressure x (Constants) = Power
• Measured in kilowatts (kW)
POWER IN IRRIGATION

To reduce power

1. Flow rate $\times$ Pressure $\times$ (Constants) = Power
2. Reduce flow rate
POWER IN IRRIGATION

To reduce power

- Flow rate × Pressure × (Constants) = Power
- Reduce pressure
FLOW RATE

- Measured in:
  - cubic metres per hour (m³/h)
  - litres per hour (ℓ/h)

How does flow rate differ between types of irrigation systems?
POWER IN IRRIGATION

Flow rate

• Irrigation system efficiency.

• The efficiency with which water is delivered from the farm source to the root zone.

• How much needs to be added to the pump flow rate to get water into the soil in the field.
POWER IN IRRIGATION

Flow rate
• Irrigation system efficiency.
• Measured as %

• Example:
• Flow rate = 100 m$^3$/h onto the soil in the field
• Efficiency = 90%
• Pump flow rate = 100 m$^3$/h / 0.90 = 111 m$^3$/h
POWER IN IRRIGATION

Flow rate

- Irrigation system efficiency

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<tr>
<th>Irrigation system</th>
<th>Min</th>
<th>Max</th>
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<tbody>
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## POWER IN IRRIGATION

Irrigation system efficiency

- Similar
- Ambiguous

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POWER IN IRRIGATION

Irrigation system efficiency

• Give or take; all non-drip are equal or similar to drip.
FLOW RATE

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Irrigation efficiency makes little difference to flow rate.
POWER IN IRRIGATION

Pressure

• Transporting water from source to field.
• Once at the field, discharging water from emitter / nozzle to get it onto the field.
• Measured in bar or kilopascals (kPa)
POWER IN IRRIGATION

Pressure

- To get water from its source to the field is the same with all types of irrigation.
- From A to B is the same.
POWER IN IRRIGATION

Pressure

- From A to B – same pressure.
POWER IN IRRIGATION

Pressure

- The differences come in getting the water once at the field into the soil.
POWER IN IRRIGATION

Pressure
- The differences come in getting the water from the field into the soil.
POWER IN IRRIGATION

To reduce power by irrigation type

- Flow rate $\times$ Pressure $\times$ (Constants) = Power
- Reduce pressure
- Cannot effectively reduce flow rate
HOW MUCH WATER AND WHEN?

Evapotranspiration (ET)
HOW MUCH WATER AND WHEN?

Reference evapotranspiration
(from grass; calculated from weather data)

\[ \text{x Crop factor} = \text{Crop evapotranspiration} \]
HOW MUCH WATER AND WHEN?

Evaporation (E)
HOW MUCH WATER AND WHEN?

Evaporation from drip irrigation (E)

Drip – E zero

Drip – E very reduced
HOW MUCH WATER AND WHEN?

Evaporation from drip irrigation is localised

Evaporation from entire surface

Evaporation is localised
HOW MUCH WATER AND WHEN?

Reference evapotranspiration
(from grass; calculated from weather data)
\[ \times \text{Crop factor adjusted (reduced) for drip} \]
\[ = \text{Crop evapotranspiration} \]
HOW MUCH WATER AND WHEN?

Evaporation component of evapotranspiration is less with drip irrigation

- Less water is used to grow the crop
- Less volume of water
POWER CONSUMPTION IN IRRIGATION

Power

• Flow rate \times\text{ Pressure} \times (\text{Constants}) = \text{Power}
• Measured in kilowatts (kW)

How much water and when

• Hours

Power consumption

• Power \times \text{ Hours}
• kW \times h = \text{kilowatt-hours (kWh)}
POWER CONSUMPTION IN IRRIGATION

Power consumption
• kilowatt-hours
• kWh

What you pay for.
POWER CONSUMPTION IN IRRIGATION

To reduce power consumption

- kWh

Power

- Flow rate x Pressure x (Constants) = Power
- kW

How much water and when

- Volume of water over the season
- Hours
POWER CONSUMPTION IN IRRIGATION

To reduce power consumption

- kWh

Power

- Flow rate x Pressure x (Constants) = Power
- kW

How much water and when

- Volume of water over the season
- Hours
UNIQUENESS OF DRIP IRRIGATION

Wetted drip profile
UNIQUENESS OF DRIP IRRIGATION

Wetted drip profile

- Becomes increasing dryer as the water moves away from the point of application

Wetted profile shape in a medium textured soil

Wetted profile shape in a lighter textured soil
UNIQUENESS OF DRIP IRRIGATION

Too dry

Just right
(roots need oxygen)

Too wet
UNIQUENESS OF DRIP IRRIGATION

To grow, a plant produces plant food
• Carbohydrate
UNIQUENESS OF DRIP IRRIGATION

Water and carbon dioxide with light form plant food

Carbon dioxide + water

Carbohydrate + oxygen
UNIQUENESS OF DRIP IRRIGATION

Water

Carbon dioxide

Water

Stomata

Leaf section

Stomata
UNIQUENESS OF DRIP IRRIGATION

Carbon dioxide enters the plant and water exits the plant via stomata
UNIQUENESS OF DRIP IRRIGATION

Stomata open and close

Open – plant growing

Closed – nothing happening
UNIQUENESS OF DRIP IRRIGATION

Too dry

Just right

Too wet

Closed

Open

Closed
UNIQUENESS OF DRIP IRRIGATION

Too dry

Just right

Too wet

Nothing happening

Open and growing

Nothing happening
UNIQUENESS OF DRIP IRRIGATION

Just right

Open and growing
UNIQUENESS OF DRIP IRRIGATION

The whole root zone under non-drip progressively goes from wet to dry after irrigation.
DRIP IRRIGATION FOR ALL
DRIP IRRIGATION FOR ALL

Sophisticated
DRIP IRRIGATION FOR ALL

Small
DRIP IRRIGATION FOR ALL

Small
- Family Drip System - FDS™
- 250 m², 500 m²
- Kit form
DRIP IRRIGATION FOR ALL

Small
• FDS™
DRIP IRRIGATION FOR ALL

Small
- FDS™
- Tank filling
- Includes fertiliser
DRIP IRRIGATION FOR ALL

Small

• Close drippers - wetted strip
• One crop type or several
SUMMARY

• Irrigation replaces crop water loss – evapotranspiration
• Irrigation types – drip and several non-drip
• kWh
  • kW
    • Flow – efficiencies similar with irrigation types
    • Pressure – can be reduced by irrigation type
  • h
    • Volume of crop water – varies by wetted area
• Drip irrigation unique
  • Ticks the above boxes
  • Unique wetted profile – increased growth
• Big and small