

# Reducing Contaminant Losses From Land Applied Farm Dairy Effluent Using K-Line Irrigation Systems.

**David Houlbrooke<sup>1</sup>, Ross Monaghan<sup>1</sup>, Chris Smith<sup>2</sup>, Charlotte Nicolson<sup>3</sup>**

<sup>1</sup> AgResearch, Invermay Agriculture Centre

<sup>2</sup> AgResearch, Woodlands Research Station

<sup>3</sup> University of Otago



# Problems associated with FDE application

- Scheduling farm dairy effluent (FDE)
- Preferential flow through mole pipe drainage
- Ponding and overland flow on sloping land
- Contamination of water bodies



# Traditional irrigator hardware



## Rotating travelling irrigator

- High instantaneous application rate ( $>120$  mm/hr)
- Uneven application distribution
- High application depth (at least 7 mm,  $>12$  mm at peak)



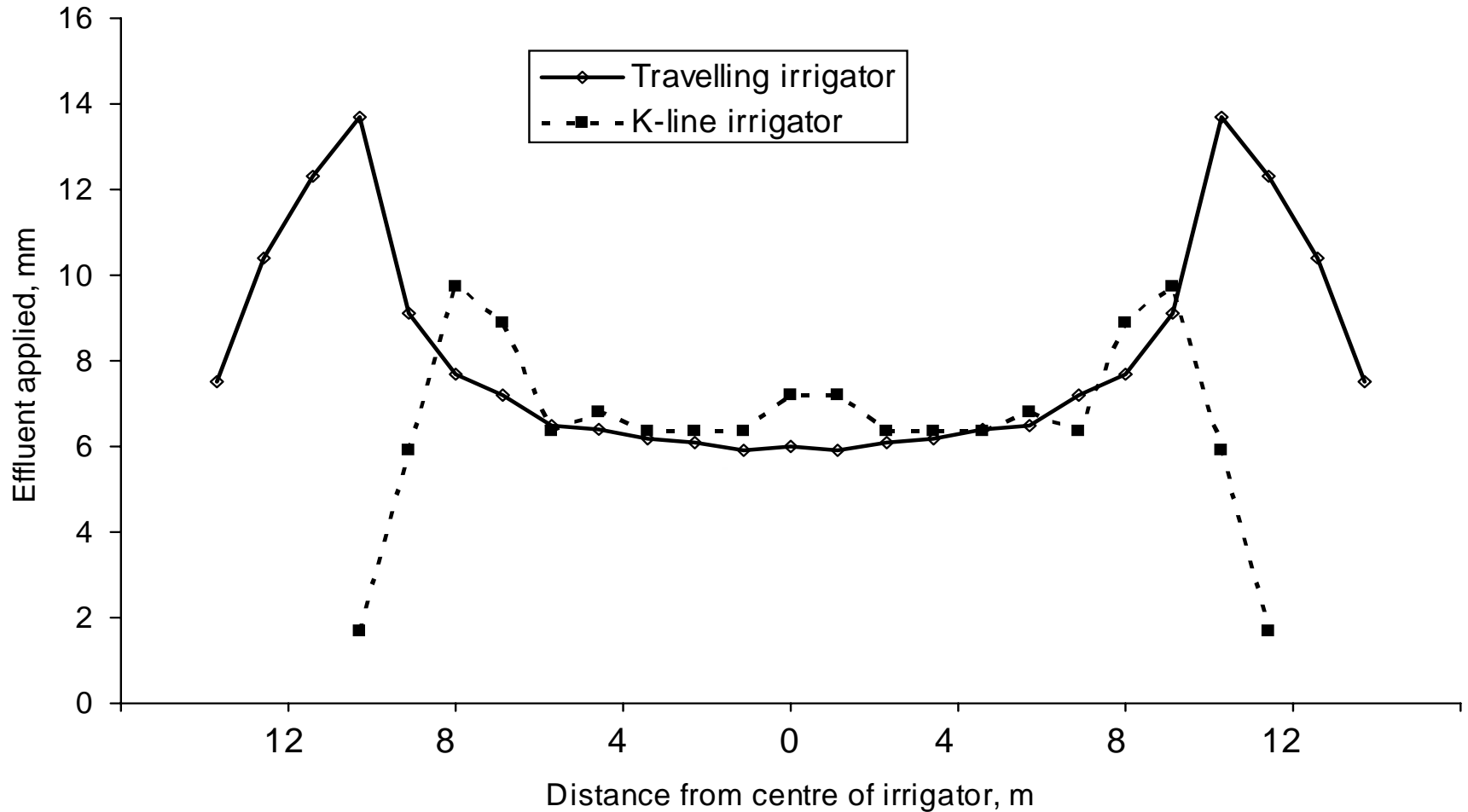
# K-Line technology

**K-Line irrigator technology can be adapted to irrigate FDE – John Scandrett (Dairy Green project).**

- Low application rate (4 mm/hr)**
- High degree of control of application depth**
- Intermittent pumping option**
- More uniform application pattern**



# Comparative distribution patterns



# Otago trial sites



**Kelso**

**Clydevale**

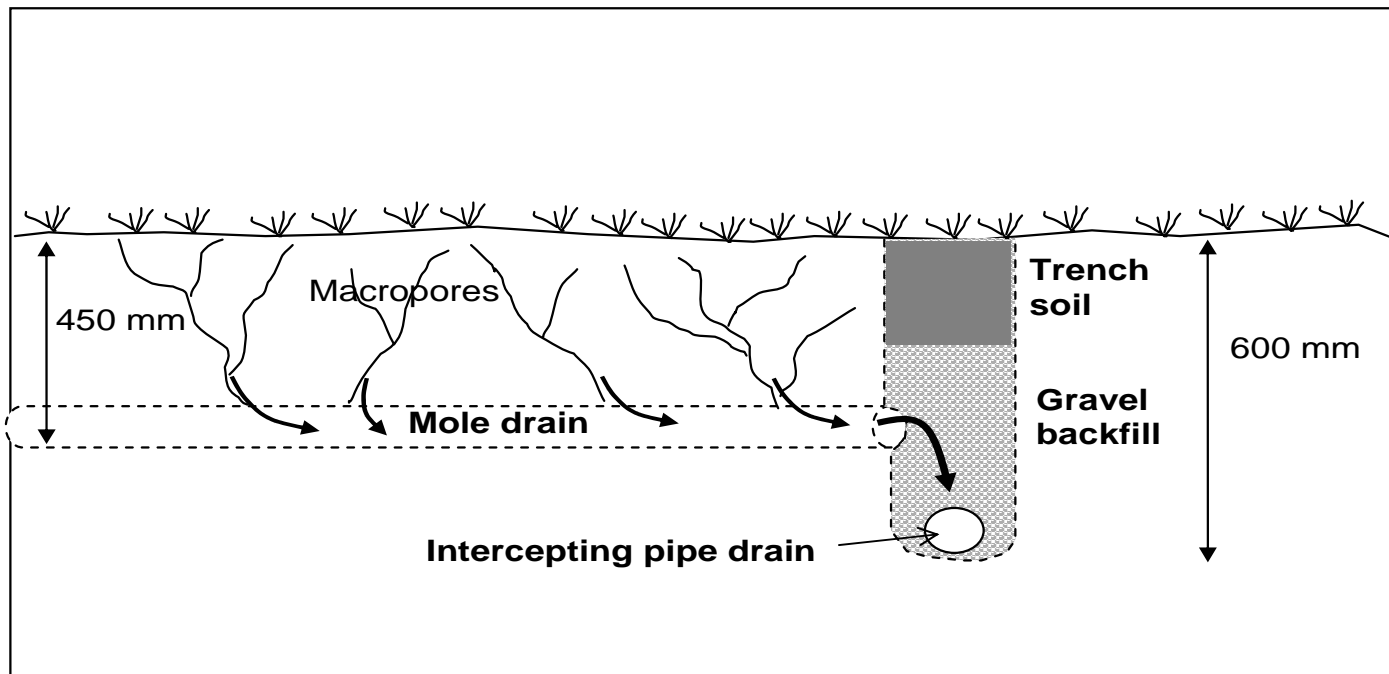
# Kelso site (mole and tile drainage)

- Two plots (40 x 27 m) of grazed dairy pasture, one irrigated with FDE
- Pallic soil (Mottled Fragic) - Waikoikoi silt loam
- Slowly permeable B Horizon, Mole and pipe drainage
- 880 mm/yr rainfall



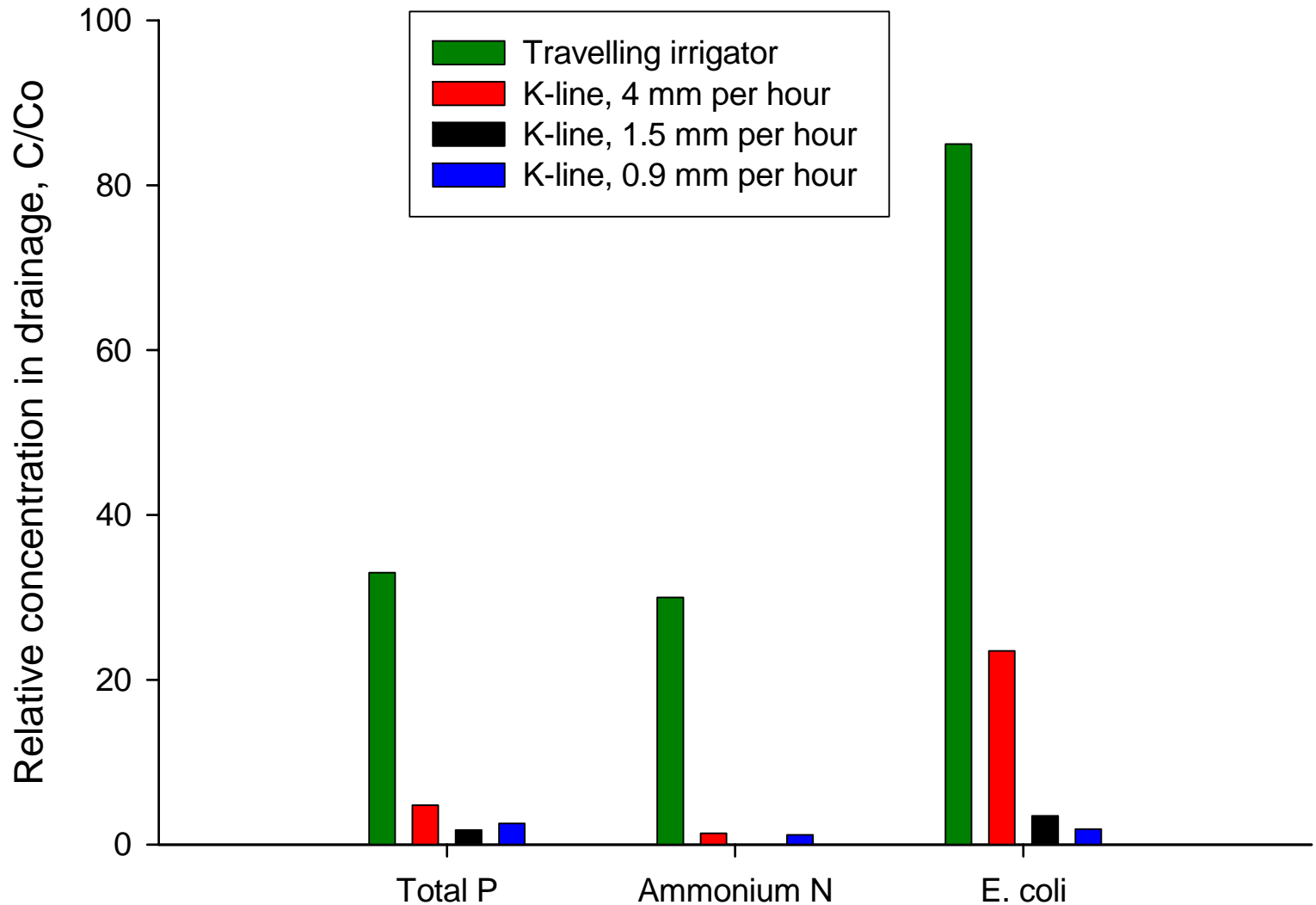
# Mole and tile drainage

- Four applications of FDE approx 8-10 mm depth
  - 1) Rotating travelling irrigator
  - 2) K-Line continuous pumping (4 mm/hr)
  - 3) K-Line intermittent pumping 25 min on, 35 min off (1.5 mm/hr)
  - 4) K-Line intermittent pumping 12 min on, 48 min off (0.9 mm/hr)



# Mole and tile drainage

Filtration of effluent: K-line v. rotating travelling irrigator



# Clydevale site (overland flow)

- 8 plots (90 x 22 m) of grazed dairy pasture, 4 subsoiled using a James Aerator
- 4 m<sup>2</sup> isolated subplot to measure overland flow
- Pallic soil (Mottled Fragic) - Waikoikoi silt loam
- Low infiltration on sloping land
- 750 mm/yr rainfall

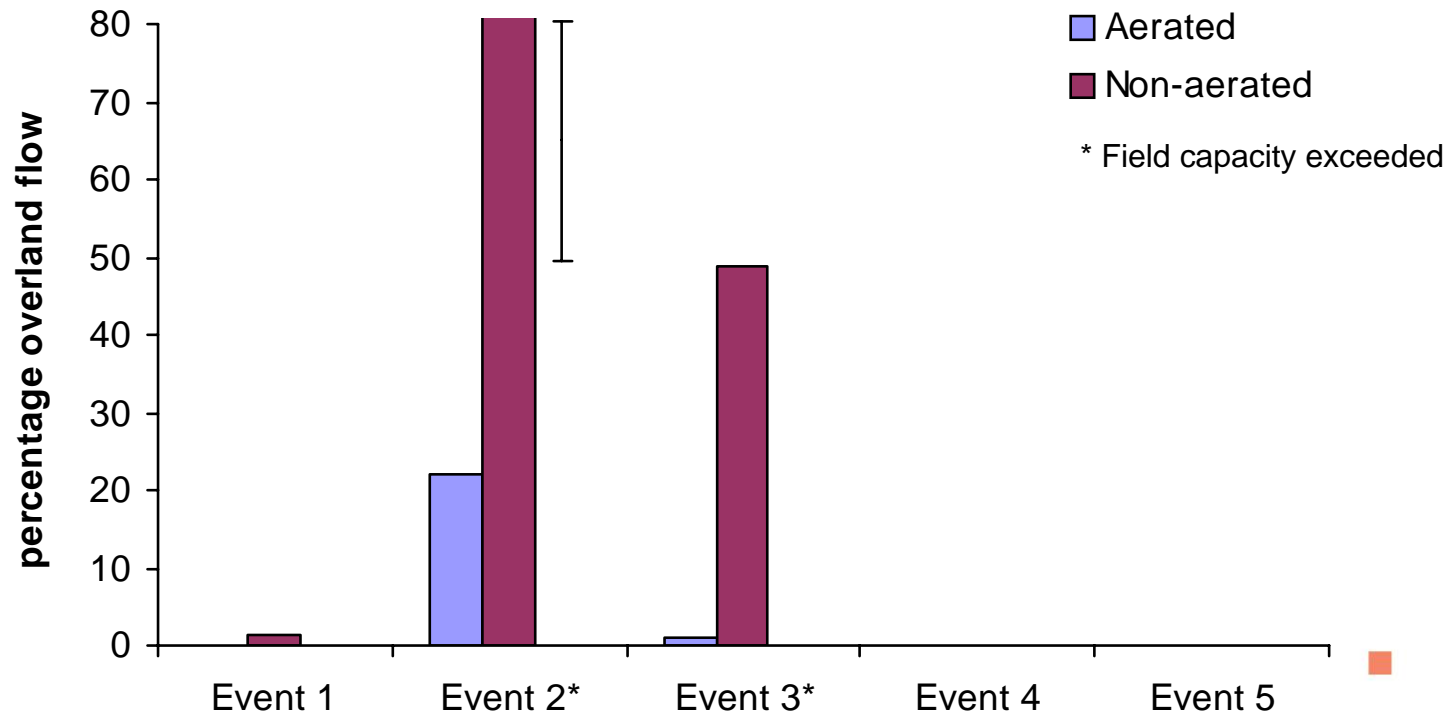


# Overland flow

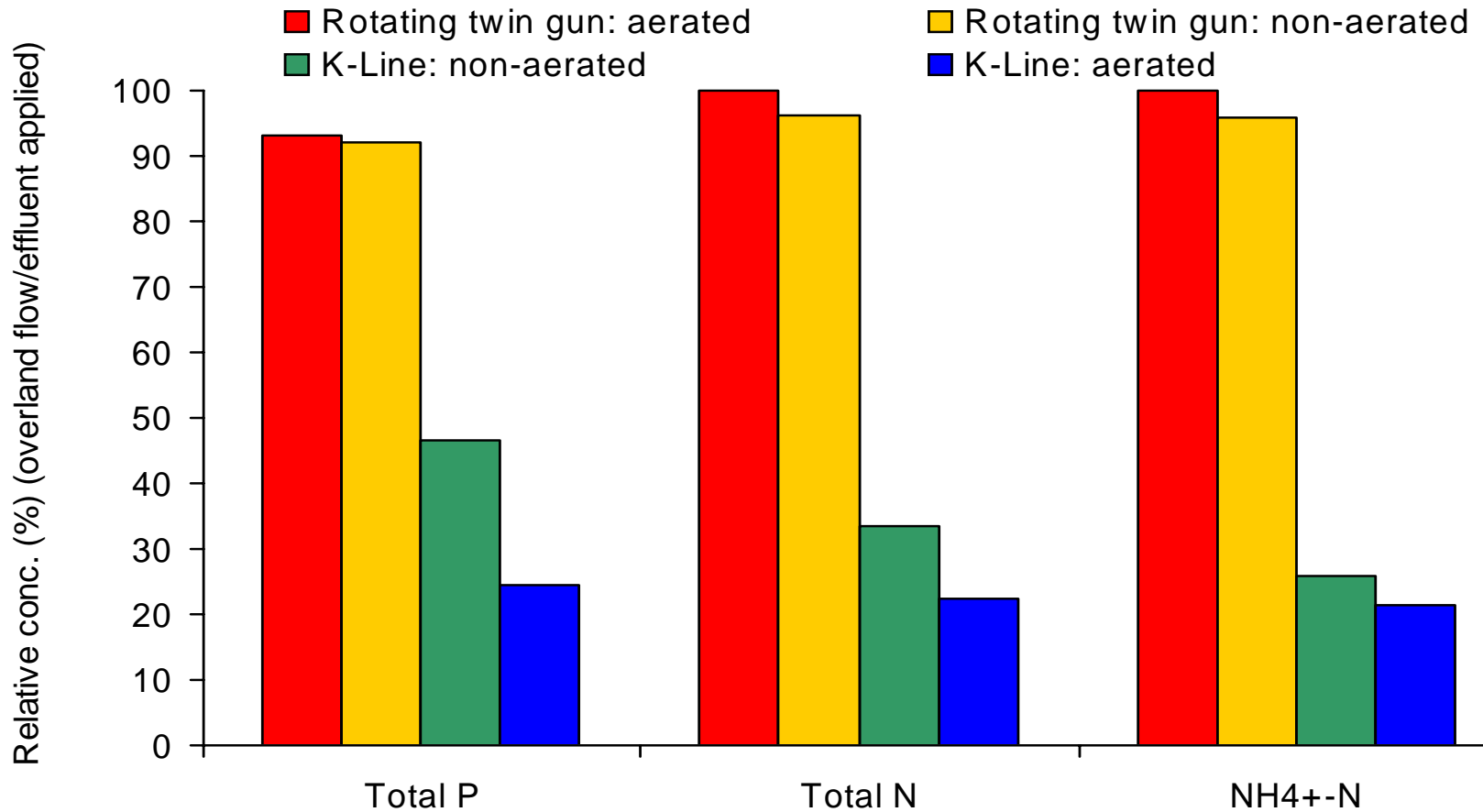
Event	Date	Irrigator	mc% v/v	Depth (mm)	Rate (mm/hr)
1	2-May	K-Line	36.8	7.0	3.5
2	30-May	Travelling	50.0	19.7	132
3	10-Jun	K-Line#	54.5	12.4	3.1
4	17-Aug	K-Line+	55.0	3.4	0.7
5	25-Nov	K-Line#	35.0	11.9	3.0

# Nearly continuous pumping (50 min on, 10 min off)

+ Intermittent pumping (20 min on, 30 min off)



# Overland flow



# Applicability of K-Line use

## 1) Mole and Pipe drained land

Fine textured soil, poor drainage, risk of macropore flow under high rate and depth application.

## 2) Sloping land with low infiltration rate

Poorly structured soil, low infiltration rate, risk of overland flow.

## 3) Farms with conventional two pond system

Where existing ponds are still discharging K-Line could provide final polish of 2<sup>nd</sup> pond discharge water via land application



# Cost of establishing K-Line system

Costs based on a 750 cow herd

<b>\$/cow</b>	<b>K-Line plus drying bed #</b>	<b>K-Line plus solids separator #</b>	<b>K-Line plus discharging two- pond system</b>
<b>Establishment costs</b>	<b>45</b>	<b>75</b>	<b>21</b>
<b>Annual costs</b>	<b>4</b>	<b>10</b>	<b>3</b>

# Includes provision for two months FDE storage

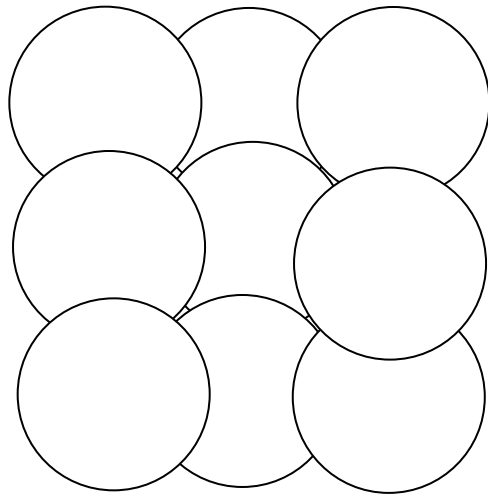
Annual cost includes maintenance, depreciation and opportunity costs



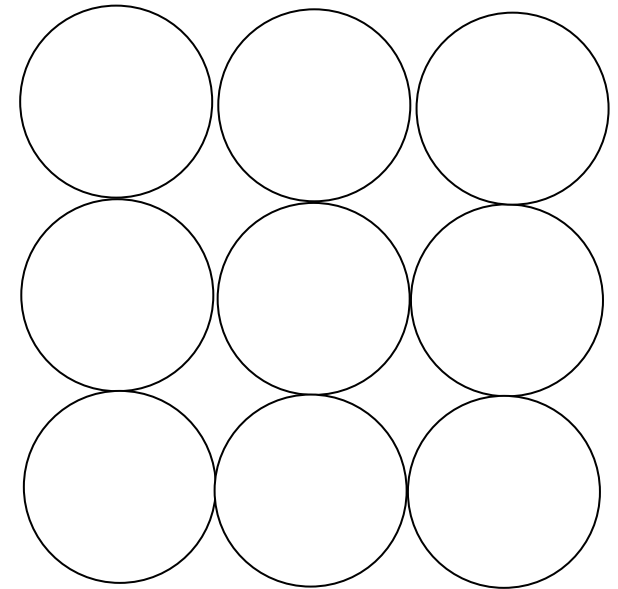
# Design criteria for K-Line use

## 1) Pod Spacing

20 m spacing is more appropriate when irrigating FDE than the K-Line industry standard of 15 m.



15 m spacing



20 m spacing



# Design criteria for K-Line use

## 1) Pod Spacing

20 m spacing is more appropriate when irrigating FDE than the K-Line industry standard of 15 m.

## 2) Intermittent pumping

The use of a timer allows greater control of depth and rate of application, 20 min on, 40 min off recommended.

## 3) Storage

The provision of at least 2 months FDE storage allows for the implementation of deferred irrigation. Reduced risk of mole and pipe drainage and overland flow events.

## 3) Pump and pressure

250 kPa of pumping pressure is required to operate 24 pods (7.5 kW pump)



# Summary

- **K-Line irrigation technology:**

- Decreased drainage and overland flow
- Greater filtration of contaminants
- Greater control of rate and depth
- Uniform application distribution

- **K-Line + storage + deferred irrigation should be considered BMP:**

- mole and pipe drainage
- rolling land with poor soil structure
- option for cost effective 'final polish' from two pond systems.



# Acknowledgments

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