Farm Dairy Effluent Irrigation Evaluations

Traveller 5

System details

- Medium traveller with rubber orifices on rotating boom
  - new "deluxe" Williams spyder irrigator
  - Used to apply all effluent generated from the shed and feedpad
  - Irrigator run at 'full' speed
  - Wetting width approx 30m
  - Overlap varies between runs with average 26 m

- Soils are variable; marine clay,
  - Significant ponding and runoff on day of visit

- Irrigation
  - Farm is not irrigated

- Effluent consents held
  - PERMITTED ACTIVITY
    - to discharge farm dairy effluent
    - not exceed the maximum nitrogen loading of 150 kg/ha/yr

Figure 1. Effluent irrigator crossing the catch can transect

Figure 2. Surface ponding resulting from high application rates on heavy soil

Effluent irrigation evaluation

Medium Traveller

This irrigator was applying effluent at rates in excess of the soil's infiltration and water holding capacities. This was identified with ponding evident in the wetting area. However, digging did not identify where effluent was in the profile. The wetting pattern was not deep enough to account for the applied depth, but there was no clear evidence of preferential flow. There were very large cracks in the profile, raising possibility that effluent had passed through to deeper levels, but none was found when soil was excavated.

A summary of system performance is given in Table 1.

Table 1: Summary of Effluent Irrigation Performance

Small Traveller	No Overlap	Overlapped	
Wetting Diameter	30	26	m
Instant Application Area	707	531	m2
Machine speed	0.34	0.34	m/min
Effluent Mean Depth	21.2	22.9	mm
Mean Application Rate	14.4	14.4	mm/h
Wetting Ring Area	304	304	m2
Max Application Rate	33.6	33.6	mm/h
Hi Quart Mean Depth	38.6	40.2	mm
Lo Quart Mean Depth	9.9	11.8	mm
DU high	1.82	1.76	
DU low	0.47	0.52	

The maximum application rate is calculated from the area of the ring wetted by the irrigator boom as it rotates. Most of the effluent is applied in a ring between 8.5 m and 13 m out from the centre of the irrigator. The effective instantaneous application rate in this small area is high, causing noticeable ponding.

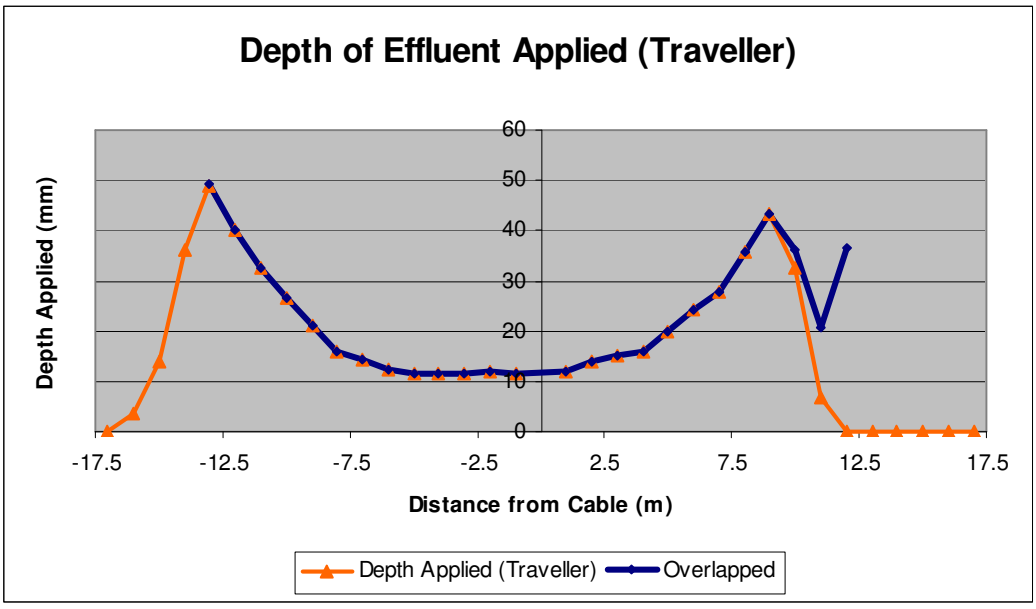

Figure 3. Effluent application pattern measured at normal pressure and full machine speed and calculated overlapped pattern based on 38m hydrant spacing

In the graph (Figure 3), the depths measured in the field are shown as the orange line. The calculated overlapped pattern is shown as the dark blue line.

The peaks at the sides of the application pattern are typical of travelling irrigators. Because of the ring application pattern and the forward movement, the sides receive effluent for a longer period than the centre of the travel path.
The low system pressure is contributing to the high peaks at the edges of the wetted pattern.

Recommended improvements

1 Avoid surface ponding

- The high application rate on small areas is causing surface ponding. This is causing redistribution through overland flow, though not to sensitive areas in the field where testing took place.
- Holes dug in the area immediately following application were unable to show clear evidence of 'preferential flow', with soil wet to only several centimetres
- Increasing machine pressure and speed will help reduce ponding. Increasing the width of the wetting ring will also help.

2 Manage pressure

- The pressure at which the machine should be operating is not known. However there is relatively little break up of droplets and effluent is applied in a narrow ring as the boom rotates.
- Increasing pressure would create smaller droplets, increase the width of the wetting band and reduce ponding effects.
- It will also increase machine speed so reduce the total depth applied at each event.

3 Increase wetting footprint

The boom applies effluent in a narrow ring.

- Fitting splash plates, diffusers or diffusing nozzles could increase the area of instantaneous application.
- Figure 4 shows a splash plate fitted to a large travelling irrigator to deflect and widen the stream from the end nozzle.
- Figure 5 shows a rubber nozzle that creates a more diffuse stream. A different machine tested with these had a much more even application.

Figure 4. Splash plate fitted to end nozzle to widen spread

Figure 5. Rubber nozzle crimped & cut to increase footprint

4 Alternate travel path positions

If successive runs are offset by half the lane spacing, high and low application areas can be overlaid. This will help moderate issues of uneven application and improve the overall uniformity over successive applications. This will not help on a single event basis, but will over the course of a season.