Farm Dairy Effluent Irrigation Evaluations

Technipharm Effluent Irrigator

Machine Details

- TechniPharm Advance Effluent Irrigator with Environozzle

- Medium traveller with rubber nozzles on rotating boom
  - new irrigator
  - Wetting width approx 33m
  - Overlap optimised ~ 28 - 30 m, no spacings gave high uniformity

The Irrigator was delivered knocked-down to the Centre for Land and Water in Hastings for assessment.

- All testing was done with clean water from an artesian bore
- Pressure was measured at entry to the irrigator with a standard pressure gauge mounted on a short length of pipe fitted with camlock fittings
- Flow was measured with a new mechanical flow meter fitted in galvanised pipe with 10 diameters up stream and 5 downstream

Figure 1. Effluent irrigator showing break-up of spray

Effluent irrigation evaluation

Rotating Traveller

- This irrigator was able to apply very low depths of effluent which indicates it could match infiltration and water holding capacities of many soils.
- The wetting pattern was typical of travelling rotating boom irrigators, with noted peaks at the edges of the travel run. However, the machine demonstrated, after allowing for appropriate over-lap, improved uniformity when sufficient pressure was available.
- The machine forward speed varied noticeably along the length of run. Maximum speed is determined by available water power but also by load. In testing at 230-238kPa on flat ground using up to 200m of 62mm OD polyethylene delivery pipe, speed variation was evident.
- The machine was tested with gearing set by the factory. The high forward speed may contribute to the higher speed variation noted in this series of tests.
- A test conducted at 170kPa showed there was insufficient power generated by the rotating boom. Loaded with 150m of 62mm hose the machine stalled. Testing with alternative gearing selected was not done.

A summary of system performance is given in Tables 1 and 2.

Table 1: Summary of Effluent Irrigation Performance at Single Transect

PERFORMANCE SUMMARY			**Run 1, Transect 2**		
			Run Spacing		
	no overlap	30m	28m	26m	24m
Wetting Diameter (m)	28	28	28	28	28
Wetting Area (m2)	616	616	616	616	616
Inside wet ring radius (m)	9.0	9.0	9.0	9.0	9.0
Outside wet ring radius (m)	14.0	14.0	14.0	14.0	14.0
Wetting Ring Area (m2)	118	118	118	118	118
Speed (m/min)	1.73	1.73	1.73	1.73	1.73
Mean Depth (mm)	4.0	5.3	5.7	6.1	6.7
High Quartile Applied Depth (mm)	7.3	7.4	7.5	7.6	7.8
Low Quartile Applied Depth (mm)	0.0	2.3	3.3	4.9	5.4
DU High Quartile	1.82	1.39	1.31	1.23	1.18
DU Low Quartile	0.00	0.42	0.59	0.79	0.81
CoV	0.76	0.42	0.31	0.18	0.15
Mean Application Rate*(mm/h)	22.1	22.1	22.1	22.1	22.1
Effective Application Rate*(mm/h)	75.0	75.0	75.0	75.0	75.0

* Note: The Application Rate is determined from non-overlapped data. The Mean Application Rate assumes the entire wetting circle receives effluent at the same intensity. The Effective Application Rate is calculated using only the “wetted ring” that receives effluent.

Table 2: Uniformity of Effluent Irrigation Performance of Run with three transects

			Run Spacing		
	40m (no overlap)	30m	28m	26m	24m
Three Transect Run					
No. of Data Points	120.00	90.00	84.00	78.00	72.00
Mean Applied Depth (mm)	5.09	6.05	6.48	6.98	7.57
CoV	0.67	0.47	0.37	0.28	0.28
Individual Transects					
T1 Mean Depth	3.8	5.0	5.4	5.8	6.3
T2 Mean Depth	4.0	5.3	5.7	6.1	6.7
T3 Mean Depth	5.8	7.8	8.3	9.0	9.7

The overall Field Uniformity coefficient of variation (CoV) of 0.28 – 0.47 at 230kPa is lower than desired, based on the Fertiliser Spreader target CoV of 0.15.

Individual transect tests (the true equivalent to Fertiliser Spreaders) had acceptable coefficients of variation at 230kPa with narrower run spacings (less distance between adjacent runs). At 24m run spacings the CoV uniformity was 0.15 and at 26m run spacings the CoV was 0.18.

The patterns at various transects are shown in Figure 2

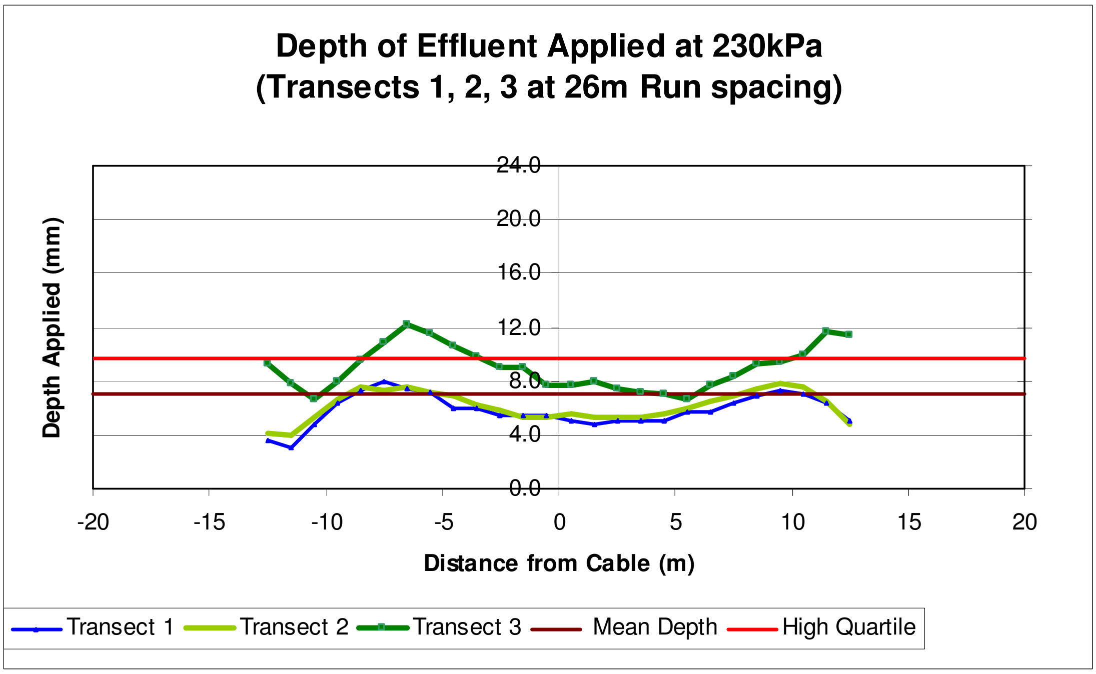

Figure 2. Effluent application pattern of three transect along a single run, measured at 230kPa pressure and full machine speed with calculated overlapped pattern based on 26m run spacing

In the graph (Figure 2), the applied depths after allowing for 26m run spacing are shown as the solid green, blue and dark grey lines. The High Quartile and Mean Applied depths are shown as the orange and brown lines.

One eighth of the effluent application area receives more than the High Quartile Depth, 7/8th of the area less than the High Quartile. It is important to consider the summed values from all transects across the entire effluent application area to determine a “Field Uniformity” value.

Figure 2 shows the higher depths applied at Transect 3 have a great effect on the overall uniformity along the whole run.

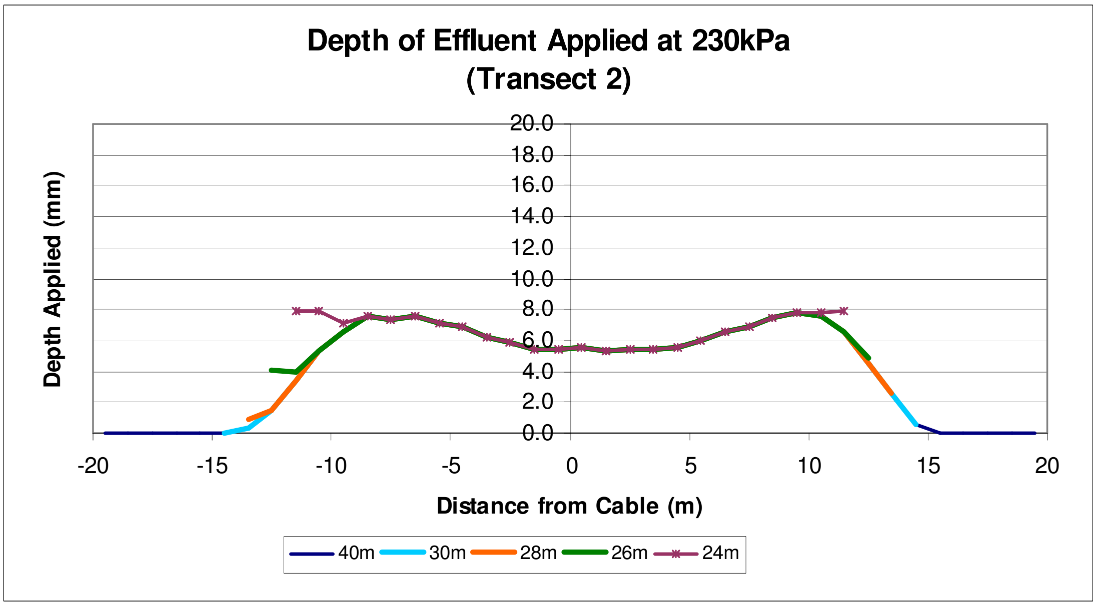

Figure 3. Effluent application pattern measured at 237kPa pressure with machine speed standardised: calculated overlapped pattern based on 40 (no overlap), 30, 28, 26 and 24m run spacings

Figure 3 shows the un-overlapped (=40m) transect depths measured, and overlapped values based on adjacent run spacings of 30, 28, 26 and 24m. Once run spacing reaches 26 – 24m, overlap gives improved uniformity. The industry does not have agreed acceptable uniformity guidelines.

Machine Performance Variables

1 Gear Speed Control

- This machine is winched by a drum powered by the turning of the rotating boom. The machine speed can be varied by changing provided combinations of cut gears.
- There is no method of governing the speed, so as terrain, hose weight or pressure vary, so does machine speed.

2 Pressure

- The testing reported here was carried out at 230-238kPa for the main run, with additional transect tests at 170 and 238kPa.
- Lower pressures had insufficient 'pulling power' and machine speed dropped as hose weight increased. Low pressures significantly reduced Field application uniformity.
- Higher pressure is noted to create smaller droplets with potential to drift. At the highest pressure used for testing (238kPa) little noticeable drift was observed. The "rooster tail" created by the Technipharm environozzle did increase finer droplets.

3 Overlap effects

- This machine exhibits the typical 'donut ring' pattern of rotating boom irrigators. The pattern has peaks at the edges of the run, which are more marked as pressure is reduced.
- Low pressure caused high speed variability, the extreme being the machine stopping.
- At the higher pressure 230kPa, uniformity was better.
- The optimum run spacing range is narrow, and points to difficulty managing wind effects and deviations from travel path in adjacent runs.
- When overlap for run spacings at 26m or closer was factored in the single transect irrigation uniformity achieved was good.
- With higher operating pressures this machine can have high uniformity with the overlapped application coefficient of variation for a single transect attaining levels of CoV = 0.18 - around the Fertiliser Spreader benchmark of 0.15.

4 Alternate travel path positions

- Running successive passes offset by half the run spacing should help improve seasonal uniformity, as is usually the case with travelling irrigators. The higher application depths at the outer edges would map over the lower centre section reasonably well.
- With the low application rates this machine can achieve, multiple passes in a season are a viable option.