Farm Dairy Effluent Irrigation Evaluations

Traveller 1

Property details

- Small traveller with rubber nozzles on rotating boom
  - Used to apply all effluent generated from the shed
  - Area also served by pivot irrigator – plan to run pivot 270 deg avoiding quarter where effluent irrigator operating.
  - Irrigator meant to be set at 'medium' speed
  - No overlap between runs

- Soils are variable; Wakanui clay loam Varies to Stoney very shallow in some places
  - Significant ponding and runoff on day of visit

- Effluent consents held
  - Store contaminants pond system and
  - Application to land where contaminants may enter water

The effluent management on this property is notable because of particular innovations that are likely to be relevant to the whole dairy industry. The progress of the effluent irrigator is tracked by GPS, and warnings sent by text to the operators should the irrigator stop moving. The machine can be turned off remotely by SMS text message.

In addition, the GPS record is maintained and mapped and can be used to demonstrate where and when effluent application has occurred and could calculate the speed of the irrigator.

Figure 1. Effluent irrigator crossing catch can transect

Figure 2. Effluent ponding from excessive rate and depth applied

Effluent irrigation evaluation

Small Traveller

This irrigator was applying effluent at rates far in excess of the soil's infiltration and water holding capacities. This was easily identified with ponding covering much of the wetting area and effluent running up to 3m to the side on sloping ground.

A summary of system performance is given in Table 1.

Table 1: Summary of Effluent Irrigation Performance

Small Traveller	**Allocated 35m Diam**	**Effective 31m Diam**	**Full Speed Equivalent**	
Instantaneous Application Area	962	755	755	m2
Effluent Mean Depth	29.5	32.2	10.7	mm
Hi Quart Mean Depth	53.8	55.8	18.6	mm
Lo Quart Mean Depth	6.6	15.9	5.3	mm
DU high	1.82	1.73	1.73	
DU low	0.22	0.49	0.49	
Mean Application Rate	14.7	18.1	18.1	mm/h
Max Application Rate	80	78	78	mm/h

The table shows three sets of performance indicators: "Allocated" is based on an assumed 35m diameter spread of the wetting pattern and lane spacing. "Effective" calculations assume the measured 31m significant wetting diameter and lane spacing. "Full speed Equivalent" values are determined from the 31m Effective values, but for an irrigator travelling at full speed (three times as fast). Note the higher speed changes the applied depth, but not rates or uniformities.

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 13m and 15m out from the centre of the irrigator. In this smaller area, the effective instantaneous application rate is very high, causing noticeable ponding and run off (see high points in Figure 3). The peaks at the sides of the application pattern are typical of small 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.

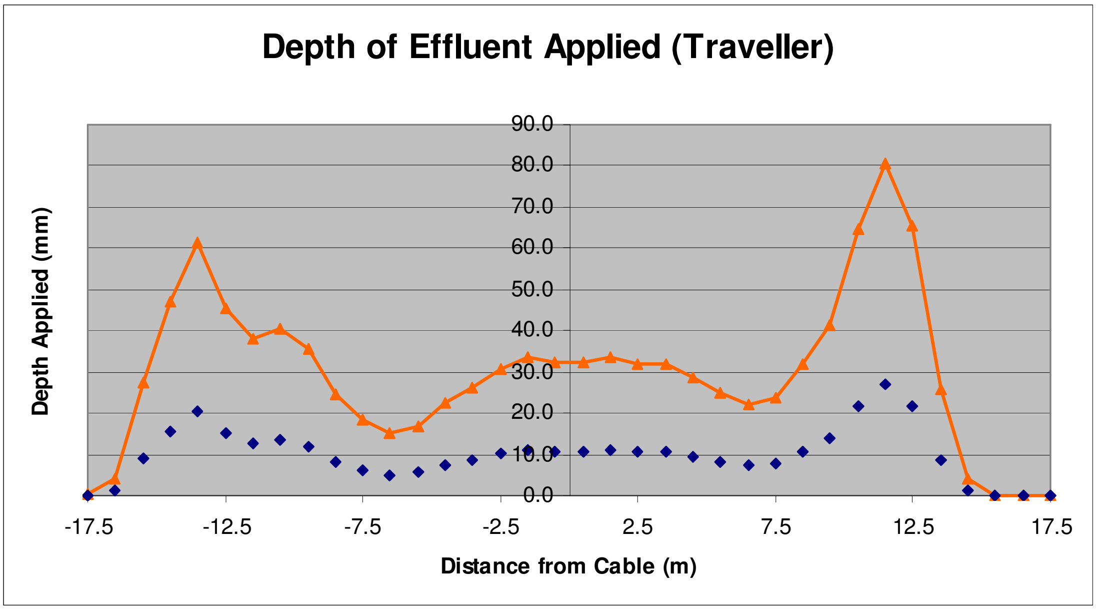

Figure 3. Effluent application pattern as measured and equivalent at full machine speed

In the graph (Figure 3), the depths measured in the field are shown as the dark orange points and line. The relative applied depth if the irrigator was set to run at full speed is shown as the blue dots.

Potential improvements

1. **The machine operating speed must be correctly set.**
   On the day of measurement, the owner ensured the effluent irrigator was tested exactly as farm staff had been operating it. After the evaluation, the machine setting were checked and found to be incorrect. It was traveling at only half the intended speed.
   - Even the intended speed will result in high application rates and depths and full speed would be preferable.

2. **Increase the wetting footprint of the irrigator.**
   The boom applies effluent in a narrow ring.
   - Fitting splash plates or alternative nozzles could increase the area of instantaneous application, and together with faster forward speed could reduce ponding.
   - 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 crimped and slit rubber nozzle that was fitted to a traveller with good performance.

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

Figure 5. Rubber nozzle crimped & cut to increase footprint

3. **Implement alternate run policy**
   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. The GPS records created by the system will help facilitate correct placement if such a policy is implemented.

   Analysis of the recorded machine progress collected from GPS records will enable a calculation of field uniformity taking any machine speed variation into account. GIS programs would be able to integrate this with the sampled machine application pattern and present it spatially.