

Technical Case Study – Ref 5.1.14

Efficiency of irrigation water delivery through drippers and micros on Citrus in Kirkwood

From April to June 2016, water delivery from emitters on 40 citrus orchards in Kirkwood (Eastern Cape, South Africa) was measured. Using the Agriwater Water Delivery Protocol measurements (ℓ/hr), two random sites per orchard were selected on drip and micro irrigation systems of various ages.

Overall 800 measurements in 40 orchards were recorded (2 sites x 10 emitter points x 40 orchards = 800 data points). Actual delivery versus the specified delivery for each dripper or micro-jet were compared and presented as a % of the specified delivery.

This Case Study highlighted the current status of variable water delivery through emitters in orchards and the implications for crop uniformity, water scheduling and savings. It also red-flagged the effects of current dripper and micro maintenance practices, cleaning of irrigation systems etc.. If a RainBox was installed in every pump house, the irrigation system would automatically be cleaned and water delivery variation minimised. Furthermore, with every new irrigation system, the damaging effects of normal maintenance practices would be avoided and the lifespan of the lines, drippers and micros would be extended.

This Case Study examines the data collected on three successive levels:

1. Level 1 examined basic summary statistics, applicable to data population studies of this nature (Table 1).
2. Level 2 looked at delivery within specific categories of irrigation efficiency at <90%, 90–100% and >100%.
3. Level 3 went deeper and looked at the variation and averages within each of these categories.

LEVEL 1

Although the summary statistics in Table 1 showed that the average was close to an ideal 93%, this was far from the reality and a common mistake made. The range and variance illustrated the seriousness of the actual situation. Water delivery varied from a minimum of 0% to a maximum of 533% of that specified – with a 17% variance from the average (mean). In layman's terms, the average water delivery was either 17% above or below the average 93% i.e., 76% or 110% of that specified and scheduled. These statistical variations in delivery had important implications in uniformity of water and fertiliser delivery in the orchards, as well as uniformity issues in timing of crop production practices.

Table 1. Basic summary statistics of 800 data points (40 orchards)

Average	Range (Min to Max)	Variance	Standard deviation
93%	0–533%	17%	4.1%

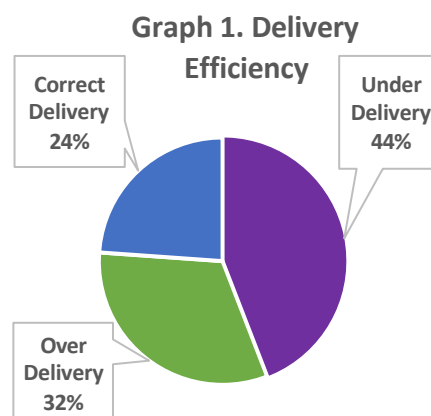
LEVEL 2

A more in-depth data review categorised in: *under delivery, within specifications and over-delivery* as:

- Under-delivery was <90% of specified delivery.
- Within specification was 90–100% of specified delivery.
- Over-delivery was >100% of specified delivery.

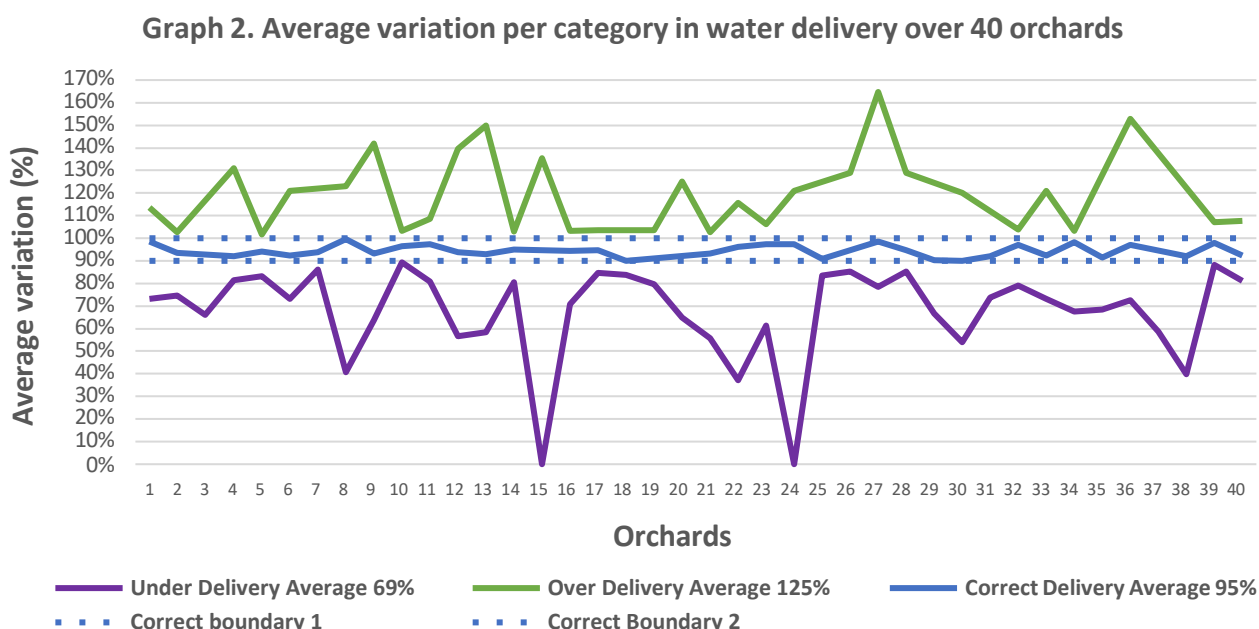
As can be seen in Graph 1 and use of the above categories, only 24% of the emitter points delivered the correct volume of water as per the original irrigation design. 44% of emitters under-delivered and 32% over-delivered.

The uneven delivery of water was caused mainly by blockages and sediment build-up in the irrigation systems as well as ineffective maintenance practices. This comparison added more depth to the summary statistics in Table 1 and variance of 17% from the average.



LEVEL 3

Graph 2 gave a deeper perspective on the under, within spec and over-irrigation categories of irrigation water supplied. It showed the average variation within each category per orchard and an overall combined perspective. For example Orchard 8 had an average delivery of 41% for all emitters' under-delivering, 100% average for all within spec, and 123% average delivery of all emitters over delivering. The variation both within and between orchards for each category could also clearly be seen.



The statistics shown in Graph 2 combined with Graph 1 portrayed a final summary of the variation in delivery efficiency of all emitters measured:

- 44% of the emitters undelivered at an average of 69% of water required (—)
- 32% of the emitters over-delivered at an average of 125% of water required (—)
- Only 24% of the emitters supplied the correct amount of water at an average of 95% of water required (—).
- Overall 76% of all emitters supplied either too much or too little water.

The practical implications of this were obvious with 76% of all trees in all orchards getting too much or too little water and fertiliser. This wasted water and fertiliser resulted in a lack of crop uniformity and made scheduling and timing of agricultural chemicals difficult.

Prepared by: Dr Derek J. Askew

B.Sc.Agric, M.Sc.Agric, Ph.D., AVCASA, Pr.Sci.Nat.

Assisted by: Gisela D. de Jager

B.Sc.Agric, M.Sc.Agric