

Evaluating Drip Irrigation Systems

February 2005 - Dan Bloomer, Page Bloomer Associates

The need for excellent irrigation management is recognised by viticulturists seeking top quality juice. But how does a grower know if their system is actually performing as they would hope? A project funded by the Sustainable Farming Fund has developed a rapid on-farm irrigation evaluation method for assessing performance and making recommendations for improvement.

The SFF On-Farm Irrigation Evaluation project has developed a Code of Practice and support software for irrigation evaluation, and training and certification for people wanting to conduct evaluations. It is funded by the MAF Sustainable Farming Fund, Pipfruit NZ, VegFed and FAR, and regional councils in Hawke's Bay and Canterbury. Support is also coming from Hydro-Services Ltd., WINZ, the Agriculture Training Organisation and the New Zealand Irrigation Association.

The methodology for evaluating drip-micro systems is based on one developed by Cal Poly in the United States. It was developed to provide rapid assessments and high quality recommendations to farmers. There are two main steps to the Cal Poly approach: assessing the distribution uniformity of the system, and evaluating how well the system is managed.

In drip-micro irrigation, Emission Uniformity is used as a measure of how evenly water is applied to individual plants by the system. If a system has low uniformity, some vines will be over-watered while others will be increasingly stressed. Both under and over watered areas will lose yield and/or have reduced crop quality. In tightly controlled grape irrigation, there is little room for system variability. However, even an excellent system with very high distribution uniformity can have low efficiency if poorly managed. System management is largely about scheduling. This involves determining the depth of irrigation needed, and the time between irrigation events, in other words, when to turn the system on and when to turn it off.

Methodology

In drip or micro irrigation system evaluations, uniformity is estimated from measurements of key variables: emitter flow variation, system pressures, block plant and emitter spacings, and uneven system drainage.

Emitter variation results from variation in manufacturing, wear and tear, and blockages. The non-uniformity is compounded by variations in system pressures, between blocks, between laterals and along the laterals. It is reduced by the number of emitter serving individual plants.

System pressures vary if valve settings are incorrect, or pipes are too small or blocked. There will always be pressure differences. Some emitter types are less affected by pressure variation, though even pressure compensating types do vary.

Some block layouts result in more emitters per canopy hectare than others. This means some plants will receive more water for a given irrigation duration.

In some cases, some emitters continue to drain after the system is turned off. If irrigations are short and frequent, this can mean certain plants receive significantly more water than others.

Taking the measurements

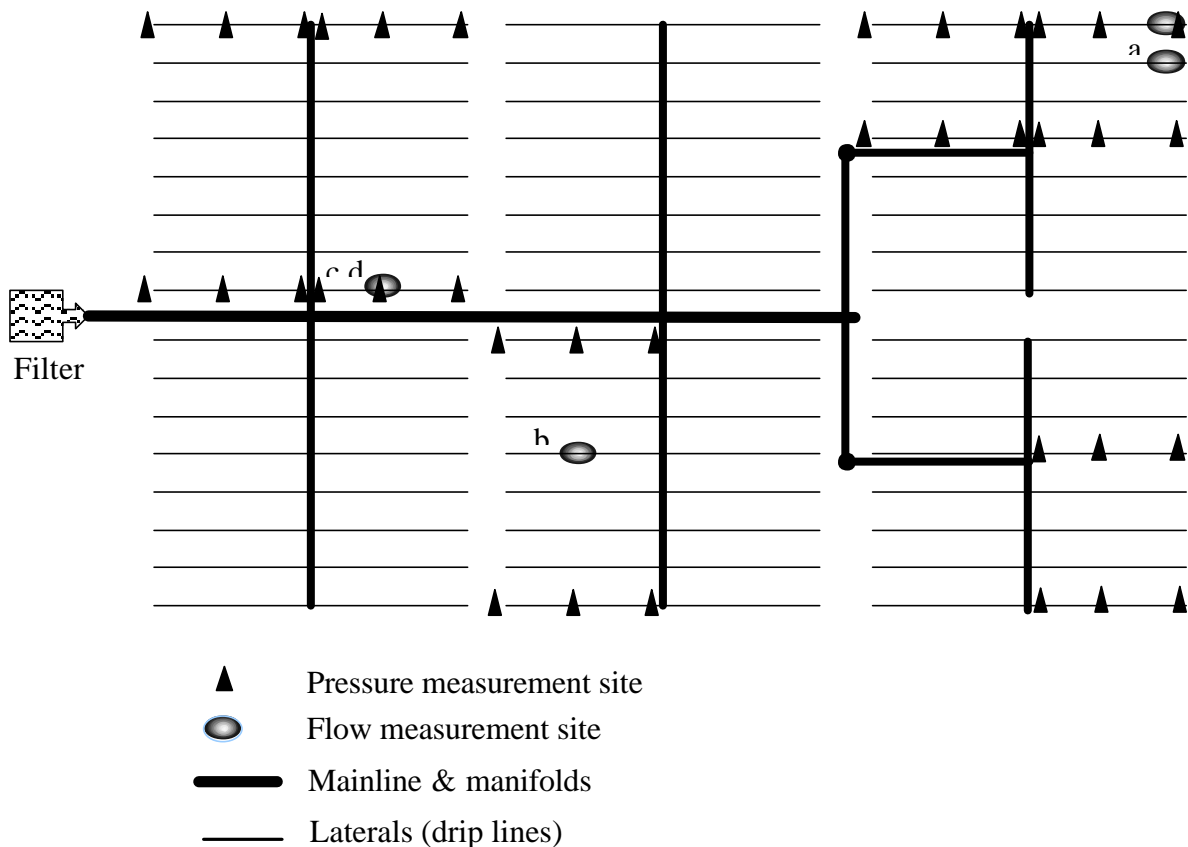


Fig 1. Drip-micro irrigation system showing location of pressure and flow measurement sites

Evaluations rely on limited measurements of critical performance indicators.

Emitter flows are tested at clean, average and dirty block locations. In the clean area, a second flow test is done at reduced pressure to determine the pressure flow relationship.

Pressures are taken across the block – the more the better. These are used to generate virtual flows which are the basis of field uniformity estimates.

Results from Craggy Range

The evaluation indicates that the system is not performing as well as might be expected with the calculated Emission Uniformity of 0.70 generally considered poor for a micro irrigation system.

Factors contributing to non-uniformity were emitter variation (27.4%), pressure variation (34.2%), block variations (38.2%), and uneven system drainage (0.3%). Adjusting run times can raise EU_{1q} to 0.77 which is considered fair.

Based on supplied information, the required Crop Irrigation Rate at the time of peak demand is 231.0 m³/ha/week or 18,249 m³/week if the entire area is irrigated. This compares to the Resource Consent allocation of 22,482.0 m³ per week. The Peak Water Use is 75.4% of the allocated weekly take.

The estimated Distribution Efficiency is 100.0%, Hydraulic Efficiency 64.9% and Headworks Efficiency 97.4%. Mainline flow speed is 1.1(m/s). Anything in excess of 1.5 m/s indicates excessive pressure losses and excess energy consumption.