Doing better with what we have: The art of surface irrigation

By Jim Purcell, Aquatech Consulting, Narrabri

Surface irrigation is the oldest, most simple, reliable and often the most cost effective form of irrigation available. But it needs the correct soils to be efficient and it is one of the hardest forms of irrigation to model mathematically.

The difficulty in modelling the filtration characteristics of the soil under surface irrigation and the lack of reliable equipment to measure the many variables has held back the adoption of technology to optimise this simple form of irrigation.

Fortunately the mathematical modelling was progressed well by Walker and Shobergoe of the Utah State University in the mid to late 1980s and is available as a Windows compatible computer program. This program was upgraded by the University of Southern Queensland (USQ) in the 1990s and additional software added.

The National Centre for Engineering in Agriculture (NCEA) at USQ then developed specialised siphon meters and advance sensors with data loggers and software. The result is the commercial surface irrigation evaluation package called Irrimate.

Aquatech Consulting, a small firm of consulting engineers specialising in irrigation and water resources based in Narrabri, NSW, began using this package with their clients in the 2000–01 cotton season. After two seasons, Aquatech worked with NCEA to upgrade and refine the package to its current form.

Measuring the flows

The service involves measuring the flow into the furrow with specialised flow meters, measuring the time the advancing flow takes to reach automatic sensors in four or eight furrows in five locations down the length of the field and, as an option, measuring the tailwater flow out of the same furrow at the bottom of the field. At the start of the season the distance and slope between each advance sensor is set and measured.

The siphon(s) with the flow meter is started the same as all the other siphons and the instantaneous flow rate and the total flow is recorded against real time automatically with an inbuilt data logger. The six advance sensors

Once initialised, the metered syphons are started and stopped as per normal.

The advance sensors down the field are triggered as the water reaches their location.

automatically record the real time when the furrow flow reaches their known location. After the irrigation, all data loggers are downloaded onto a Palm Pilot hand held computer via an infrared link and the depth of water flow in the top of the furrow measured.

This data is then analysed using two computer packages — Infilt and Sirmod II — which define the infiltration characteristics of the soil and calculate the depth of irrigation application down the length of the field.

Once the computer models are calibrated against the actual field measurements, they can be used to predict the results of changing any variable in the irrigation process:

• Furrow flow;

• Irrigation period or set time;

• Run length;

• Slope; and,

• Soil moisture deficit at irrigation.

The best combination of these variables can be trialed to determine how to get the highest irrigation application efficiency within the practical constraints determined by the grower.

Typically, good irrigators are saving between 0.1 and 0.25 megalitres per hectare per irrigation by using this process. Others are saving even more. As a bonus, irrigators are also getting a very good feel for the effects of changing siphon flow rates and set times. They are becoming better irrigators as well as saving up to one irrigation per season.

Case Study 1

This farm was on medium grey cracking clay soils with 700 metre runs and 1:900 slopes. By changing from one to two 63 mm diameter siphons every second furrow and reducing the irrigation set time from 12 hours to six hours, it was possible to save 0.21 megalitres of water per hectare per irrigation.

The irrigation application efficiency was raised from 68 per cent to 89 per cent and the application depth was more even from the top to bottom of the field.

Case Study 2

A farm on lighter grey cracking clay soils with 900 metre run lengths and 1:800 slopes. The grower was wanting to irrigate on smaller soil moisture deficits of around 50 to 60 mm using double 63 mm diameter siphons running every second furrow.

Initialisation and downloading of data from the advance meter is done with a Palmtop computer.

A flume located at the bottom of the field accurately measures tailwater.

With a 12 hour set time, the average depth at application was 90 mm compared to his deficit of 50 mm. The irrigation application efficiency of the measured event was 60 per cent.

By increasing the furrow flow rate by a further 150 per cent it was possible to raise the application efficiency to 75 per cent and save 0.2 megalitres per hectare per irrigation with the same deficit.

The grower wanted to improve further and cut the field into two 450 metre long fields and irrigate with a slightly higher soil moisture deficit. By using a medium furrow flow and irrigating for seven hours, he was able to lift his application efficiency to 88 per cent and save a further 0.1 megalitres per hectare per irrigation.

Case Study 3

A farm at Moree with heavy grey clays and 800 metre run lengths with a 1:1100 slope at pre-irrigation. The farmer had already changed to double 63 mm diameter siphons from previous evaluations but wanted to save water on pre-irrigation.

He ran high furrow rates for 16 hours and applied an average of 1.9 megalitres per hectare with good uniformity. By cutting back to 10 hours set time with the same furrow flow rate, he was able to apply 1.6 megalitres per hectare. This saving of 0.3 megalitres per hectare at pre-irrigation allowed him to irrigate some fields a further time in a very dry year.

Summary

By using the commercially available Irrimate field equipment and computer models, growers are able to change the traditional irrigation practices to reduce water use and increase production. Aquatech Consulting in Narrabri has been using this service with their clients for three seasons now and have expanded the service to other consultants in Warren, Toowoomba, St George and Emerald.

It is hoped that qualified Irrimate-trained consultants will be available to provide the Irrimate service in all cotton growing areas by next season.

For further information contact Jim Purcell, director of Aquatech Consulting at Narrabri on 02 6792 1265.