Leading Edge, supported by the Society for Engineering in Agriculture and the Australian Centre for Precision Agriculture, provides a local and worldwide window on engineering and PA research.

Seepage research identifies knowledge gaps

By Gary Alcorn

Unseen seepage is often the major factor in on-farm water storage losses which are robbing growers of millions of dollars in production each year.

Toowoomba firm, FSA Consulting, recently studied three Darling Downs farm water storages closely, quantifying the various water loss components — evaporation, seepage and operational losses.

FSA Consulting agricultural engineer Nathan Heinrich said the project was commissioned by the Condamine Alliance with support from Cotton Australia, Darling Downs Cotton Growers Association and Central Downs Irrigators' Limited. Other agencies involved included Cotton CRC, QDPI&F and the National Centre for Engineering in Agriculture (NCEA).

"NCEA pioneered the use of pressure-sensitive transducers (PST) to measure water depth in on-farm storages to quantify evaporative losses. We used the same technology and water balance method to evaluate seepage losses," said Nathan.

"This technology is now available commercially through the Irrimate network for individual property owners to measure real-time water losses from their storages," he said.

They employed an FAO model (Crop Evapotranspiration — Irrigation and Drainage Paper 56) to calculate evaporation losses. Meteorological data came from an AWS operated by DDCGA at Norwin.

As no inflows or outflows to each storage occurred during the monitoring period, measuring water depth change and subtracting the calculated evaporation gave the seepage loss rate. This is known as the water balance method.

They found seepage losses ranged from 0–14 mm/day. The volume of water lost will depend on the surface area of the particular storage.

"As well, we evaluated the use of a low-cost commercially available soil amendment product (Soilpam) as a seepage mitigation agent in one sump," Nathan said.

That sump (Storage A) is located in the prime alluvial black soil Brookstead district on the Darling Downs. Measuring 0.5 hectartes and containing eight megalitres when full, it adjoins a large ring tank which provided ample replenishment water.

The PST was positioned on the sump floor and sent water depth data continuously to a data logger. The average value was calculated every 15 minutes and downloaded every two weeks. (This unit had an accuracy of plus or minus 0.04 per cent in water depths from 0–3.5 metres).

Once the seepage loss was quantified (up to 14 mm/day), it was time to evalu-

Applying Soilpam to the water surface.

Australian Society for Engineering in Agriculture

The society contributes to the development of a strong engineering involvement in agriculture to aid economic growth and environmental sustainability for the entire Australian community.

WHO CAN JOIN SEAg?

Membership is open to anyone interested in the application of engineering to agriculture and related industries. This includes scientists, farmers, surveyors, technical officers, engineers, manufacturers, distributors and processors.

REGIONAL BRANCHES

Members can contact their local branch to discuss activities.

NSW:	Helen Fairweather	02 6881 1211
Qld:	Guangnan Chen	07 4631 2525
Vic:	Brendan Williams	03 5381 1975
SA:	Paul Harris	08 8303 7880
WA:	Chas Holmes	08 9457 2876
Tas:	John McPhee	03 6421 7674

or www.ncea.org.au/seag/seag.htm

ate Soilpam. It is a polyacrylamide containing 90 per cent acralymide/potassium acrylate co-polymer and 10 per cent inerts.

In contact with water the negatively-charged compound attracts suspended soil particles and sinks to the storage floor.

The product forms a mesh of long chain polymers which should block soil pores and reduce infiltration.

Using a high rate of 60 kg per hectare (cost $600 per hectare), about 32.5 kg was applied to the 0.54 hectare surface area of the sump on April 15, 2005.

"We applied this sugar crystal-sized chemical to the water surface through a home garden leaf blower from a dinghy," Nathan said.

A second application at 60 kg per hectare was made on May 10, 2005.

Real time monitoring and recording of water storage water depth occurred over 71 days in three stages. They were Pre-mitigation treatment (PMT); Mitigation treatment 1 (MT1) and Mitigation treatment 2 (MT2).

PMT was measured over 29 days and showed water depth declined steadily from 1705mm to 1230mm before top-up for the mitigation treatment.

Data analysis revealed average daily water loss was 18 mm per day including four mm per day by evaporation. The seepage loss rate was equivalent to 2.3 ML per month or 28 ML per year which confirmed the owner's experience (see Figure 1).

In MT1, water depth was recorded for 25 days a it declined from 1740 mm to 1296 mm. Average daily water loss was 17 mm per day with evaporation loss estimated at three mm per day. Although evaporation rates varied between 2–4 mm per day seepage losses remained consistent at 14 mm per day (see Figure 2).

FSA concluded that Soilpam had no effect on reducing seepage rate at this site.

In the MT2 treatment water depth was recorded and monitored for 16 days. Water depth declined steadily from 1304 mm to 1068 mm. Rain fell on three days. Average daily water loss was 15 mm per day including three mm per day in evaporation (see Figure 3).

FSA concluded that the second Soilpam treatment had little effect in reducing seepage losses at this site.

Seepage losses were determined at two other storages, not known to have excessive losses. Data logging showed seepage losses of less than 1.4 mm per day (within the accuracy of the sensor).

56 ▷

FIGURE 1: Pre mitigation treatment (PMT)

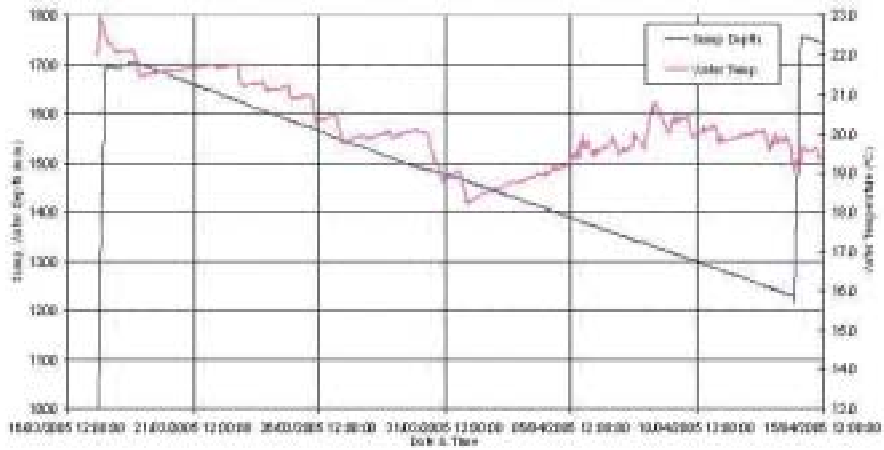


FIGURE 2: Mitigation treatment 1

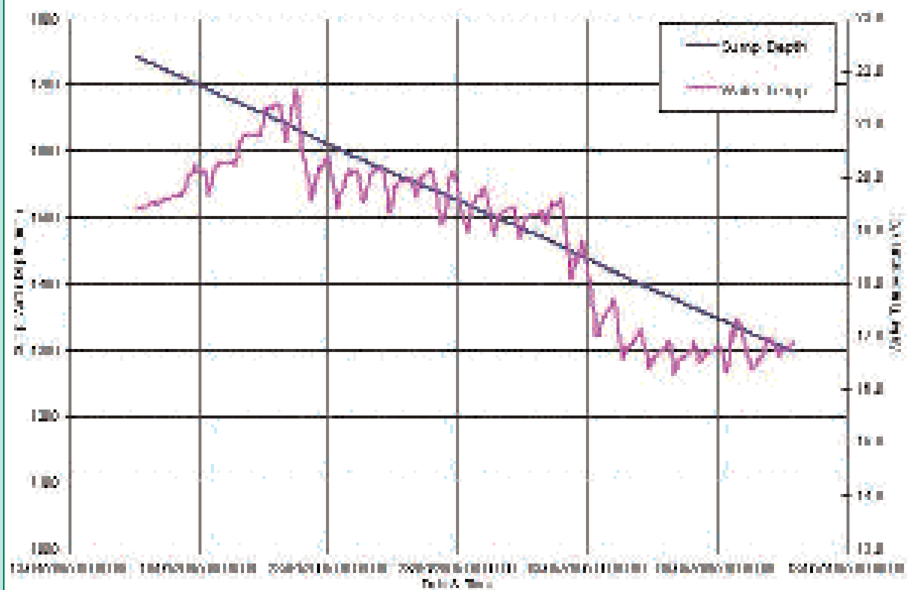
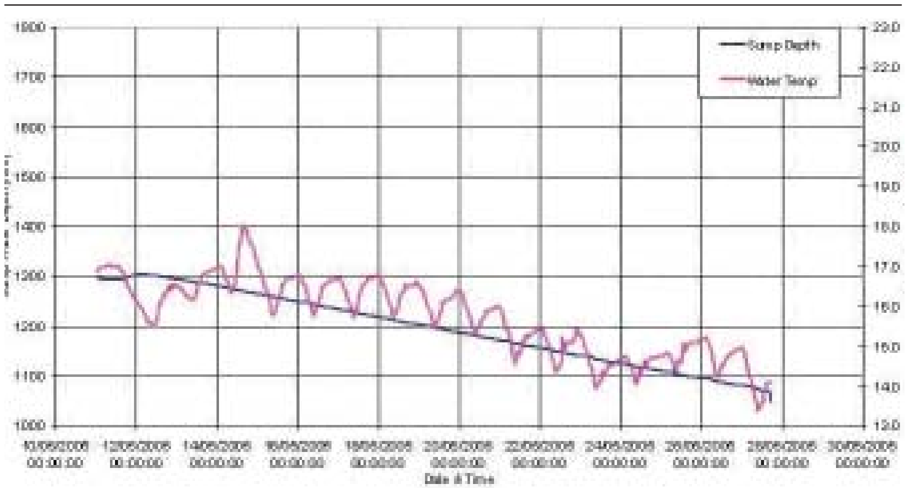


FIGURE 3: Mitigation treatment 2



◁ 55...SEEPAGE RESEARCH

FSA'S CONCLUSIONS

Real time monitoring of water depth using PSTs and the water balance method has been shown to be a reliable method for determining seepage losses from clean water irrigation storages.

The period of monitoring (with no inflows or outflows) must be of sufficient duration to improve resolution in the calculation of seepage loss.

But to accurately determine seepage losses below 1.0–1.5 mm per day, more research is required to assess the effects of more accurate instrumentation and the stability of such equipment.

Accurate determination of seepage losses is of paramount importance with regard to storage of effluents, where acceptable losses are considerably lower than with clean water storages.

As well, the applicability of the FAO 56 calculation procedures to estimate evaporation from water storages needs further investigation. Current knowledge suggests that these procedures are appropriate; but this needs to be proven with further research.

The seepage losses from three storages on the Central Downs were quantified. Seepage losses were found to range from 0 to 14 mm per day. Other work carried out by FSA Consulting over the past 12 months, found seepage losses from on-farm water storages varied between 0 to three mm per day.

For storages where the seepage rates are excessive, such as Storage A, chemical methods of remediation (such as Soilpam) may not be appropriate. But more definitive research into this area is required.

Another option to correct excessive seepage losses is a physical barrier, such as an impervious liner, and for a small storage similar to Storage A, this may be economically feasible.

A pressure sensing transducer (PST).