Alberta Farmer Express

Bringing crops indoors generating research insights

Indoor beds allow scientists to take 'a peek underground' to see how subsurface drip irrigation works

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May 1, 2018

An array of sensors allow researchers to monitor water movement in different soil types within beds sown to alfalfa. *Photo: Willemijn Appels*

Indoors' doesn't usually come to mind when thinking of applied irrigation research, but it has its advantages.

"We have to be careful (with field studies) because you might harm somebody's crop or interfere with whatever the farmer had planned," said Willemijn Appels, a hydrologist and soil physicist.

"You can't push systems and the crops growing based off those systems quite to the extreme that you might need to really understand what's going on in the soil."

Two years ago, the Dutch scientist became the inaugural Mueller Applied Research Chair in Irrigation Science at Lethbridge College and has since been investigating how differing subsurface drip irrigation setups and management techniques affect the movement of water in different soil types. The college recently completed a new trades facility that includes a large space for collaborative applied research between scientists and community partners (in this case, drip irrigation supplier Southern Irrigation). This provides a controlled environment for testing equipment and not only runs test plots year round, but pushes crops to extremes.

Producers in southern Alberta experienced a real-life version of that last summer during a prolonged spell of hot, dry weather. One of them was Ken Coles, general manager of Farming Smarter, a farmer-run research organization.

Coles has irrigated 110 acres with subsurface drip for the past two years and installed an additional system on 20 acres last year. He's been happy with the efficiency of the system, but last year's drought created some challenges.

"It got so dry we didn't really get the water to distribute both horizontally and vertically to the degree I hoped," Coles said.

He speculates that even a tiny bit of rain might have made a difference to how the system performed. There was no rain through most of the growing season, and so the top of the soil crusted. That may have limited water movement in the soil.

"A little bit of rain that would soften the top up and probably would have given the water a chance to move up," Coles said. "And a little more time back under zero till (would have helped) because we did have to till it after we installed it. I do think that it's going to be one of those things that needs to be in combination with zero till."

Lethbridge College researchers built three raised beds — six metres long, three metres wide, and 90 centimetres deep. Each has a different soil type (donated by area producers): sand, clay, and loam. The large beds allow the drip lines to be installed at distances found in the field, with multiple configurations in each bed. Each has four individually controlled drip systems that can be run independently of each other. They are set at two different depths and with two different emitter spacings along the lines.

"We're experimenting with time and frequency of applications, and the effects of that on the shape of the wetted area around the emitters," said Appels. "The main goal is to get water to go up and sideways and not down too much."

The test plots are planted with alfalfa because it has deep roots and uses a lot of water.

"The main problem with these types of experiments is not so much getting the water in, but getting it out when you want to do a second experiment."

A large collection of sensors installed throughout the beds enable the researchers to track water movement in close detail, including how quickly it moves in all directions within the soil.

"Normally, you can't really see what is happening but now that we've heavily instrumented these beds, you can pretty much have a peek underground," said Appels.

There are also weather stations (despite it being an indoor facility) that monitor air movement from things such as ventilation systems, as this can create differences in evaporation and transpiration.

Willemijn Appels. *photo: Gregory Thiessen*

Currently, one of the main attractions of subsurface drip is the ability to irrigate irregularly shaped fields. It can also reduce disease and weed germination (because neither foliage or the surface of the soil gets wet) while offering both water and energy savings.

But Appels and her fellow researchers hope to give farmers one more reason to consider subsurface drip. While they're currently just looking at water movement, they hope to move on to fertigation.

“One of the big promises of subsurface drip irrigation systems is that you can not only apply water directly where the roots are, but also the nutrients,” she said. “If you can put nutrients such that they’re more accessible to the crop, then you might push yields, or at least very much improve the nutrients use efficiency.”

Applying nutrients directly to the roots can result in yield increases.

“Just the watering itself might be just increasing water use efficiency — but yield increase, that would make a larger public interested in doing this,” said Appels.

Coles has used his system for fertigation and had some banding in his fields because the water didn’t distribute evenly. He’s looking forward to the results of this research project.

“First you have to distribute the water well, then you can distribute the fertility well,” he said.

The researchers also want to ensure their work benefits producers in southern Alberta.

“We hope to do some outreach to people who have already implemented the systems so they see the effects of implementing various management decisions,” said Appels.