As drought conditions persist and water supplies are pressured, an increasing number of farmers, including no-tillers, are turning to subsurface drip-irrigation systems to maximize water use.

Subsurface drip irrigation (SDI) involves the installation of small “drip tape” water lines 1 to 2 feet under the soil. At controlled intervals, water and fertilizer is pumped through the lines into the root zone for uptake by plants.

Drip irrigation is attractive to some no-tillers because the buried water lines minimize equipment traffic and compaction in fields and can improve water- and fertilizer-use efficiency.

High crop prices could bring a return on investment with SDI more quickly than ever before. But before making the switch, no-tillers should prepare an analysis of the installation and labor costs in comparison with center-pivot and flood systems.

Fine For Row Crops

Drip irrigation was first commercialized in the 1960s and now accounts for over 50% of the irrigation of horticultural and specialty crops in the U.S.
Today, the practice has expanded to soybean, corn, wheat and cotton acres, and it’s an attractive option for fields with slopes, obstructions or irregular shapes.

The use of drip irrigation on row crops in the U.S. has increased from around 400,000 acres in 2003 to 640,000 in 2008, the USDA says in a 2009 report.

Drip irrigation can work on slopes, although most farms with the technology have slopes less than 10%. Pressure-compensating drip lines can be chosen to accommodate more severe slopes.

The system has even been adopted on some flat fields that were once center-pivot irrigated because as much as 32 acres out of 160 is either not sufficiently irrigated or getting no water at all.

In a typical drip-irrigation system, water is pumped from its source through filters and into PVC pipes that carry it to a network of buried polyethylene drip lines with emitters.

The drip lines are usually spaced about 60 inches apart, but exact placement depends on soils, climate and row-management practices.

Farmers usually install sensors that measure below-ground moisture levels and track the crop’s water-use levels to match with application rates.

“The challenge is making sure plants get an even amount of water and fertilizer,” says Inge Bisconer, technical marketing and sales manager for Toro Micro-Irrigation. “Once the system is designed, the farmer’s job is to calculate how often to run the system, and for how long, to satisfy crop demands.”

For example, if the drip system’s application rate is 0.05 inches an hour and water use is 0.20 inches an hour, the farmer needs 4 hours of operation per day to satisfy crop requirements.

**Leading The Pack**

Companies such as Toro, John Deere and Netafim are among the leaders in drip irrigation systems.

Toro makes most of the components and sells them to dealers, who design and install the system for customers and provide service and operational support afterward.

Several years ago, John Deere invested heavily in the drip-irrigation business when it purchased two U.S.-based manufacturers of drip tape — Roberts Irrigation and T-Systems, as well as Plastro Irrigation Systems, a micro-irrigation company in Israel.

Deere makes and supplies drip tape and a variety of emitters, and sources filters and valves through an OEM agreement. Meanwhile, dealers source PVC lines and handle the design and installation of the systems.

One additional benefit for the Deere system is the ability of farmers to use the FieldConnect system to view soil-moisture data online and manage their irrigation system.

Some farmers install SDI systems themselves, but dealers most often handle it because they possess the necessary installation rigs and trenchers...
“We’ve always figured it costs $10 per acre-inch for irrigation, and depending on the year, drip irrigation can save us 6 inches very easily. It adds up in a hurry…”

— Joe Lundeen

and the expertise in putting valves together, Bisconer says.

Drip irrigation is popular with no-tillers, she says, because it reduces the amount of field traffic compacting the soil, and there are no pipes on top of the ground.

Deep-ripping or vertical tillage that is popular with some no-tillers or strip-tillers could still be done if the pipelines were laid out with RTK guidance to map the locations.

“Water and fertilizer can be applied without running a tractor through the field,” Bisconer says. “Organic farmers have been interested because you’re only applying water where the crop is, and not around weeds.”

Whether it’s 30-inch corn or wheat that has been drilled or broadcast, the seeds and plants are getting moisture and farmers can work the soil surface to accommodate crops.

“If you can double yields, the system still pays for itself at $7 per bushel,” Bisconer says.

For Deere’s drip-irrigation business, the majority of customers in the row-crop market seem to be no-tillers, says Jim Chambers, manager of global product marketing for John Deere Water.

He believes it’s possible for no-till to help SDI systems work better in dry areas.

“If there’s one thing SDI can be faulted for is when you’re in a dry area and you don’t have moisture at planting, it’s harder for the SDI system to push moisture up into the seedbed to start germination,” Chambers says. “In no-till, you’re more likely to hold moisture in the top soil profile over the winter, so you’ll get better germination.”
The Cost Factor

Higher installation costs of drip irrigation, compared to center-pivot systems, has been an impediment to greater adoption.

But this may change as water districts and government agencies impose more stringent water restrictions for surface and groundwater resources, such as with the Ogallala aquifer in the Great Plains.

As water resources become more limited and expensive, the water-saving nature of SDI — as well as high commodity prices — may offset the higher initial cost.

The cost for drip irrigation is usually $1,100 or $1,300 an acre in fields with corn or cotton, but the range can run from $700 on the low end to $1,500 to $1,800 an acre, Chambers says.

Water quality can be a big cost factor if top filtration equipment is needed, and soil texture dictates how far apart the drip-tape laterals must be placed. Lighter soils require tighter spacing and heavier soils wider spacing.

Water with high levels of algae, sediment or iron precipitants may need higher levels of treatment than just a screen filter. Surface water, such as a canal or reservoir, typically has higher filtration requirements than well water.

Most of the labor cost with SDI is installing the system, Bisconer says. After that, labor is limited to maintaining the system, which includes reading pressures and flows and monitoring soil conditions. Some flushing or chemical injection, or repairs of broken lines, may be needed.

“But with gravity irrigation, you’re digging out rows, moving pipe, repairing gear boxes and changing sprinkler heads,” she notes. “Every irrigation system has a labor component.”

Getting Results

Evidence seems to be mounting that drip irrigation can boost water-use efficiency and yields in major field crops like corn and soybeans.

For example, it’s becoming a popular practice on irrigated acres in Nebraska, where water supply is becoming a serious concern for farmers.
Toro shared some scenarios with farmers and researchers who’ve utilized drip irrigation:

Grand Island, Neb., farmer Ken Seim, who farms 1,400 acres of corn and soybeans, says flood irrigation is about 40% efficient, pivots between 60% and 70% efficient and drip irrigation is over 90% efficient.

He applied 9 inches of water to drip-irrigated fields in 2012 and achieved the same results as 20 inches of water applied to his center-pivot fields and 22 inches of water to his gravity fields. He estimates labor costs with SDI are one-third of that with flood irrigation, and they’re about the same as with pivot.

“I can also build early-season soil moisture with drip irrigation after a dry winter,” Seim says.

Seim’s neighbor, Gary Greving, who farms 1,100 acres of soybeans, says plant health improved with drip irrigation and yields increased 40% since the installation.

“T he stem of the plant was twice as thick, the leaf area larger, the plant taller and the pod count over double,”

Some Questions To Ask

If a no-tiller is interested in drip irrigation, Joe Lundeen advises them to check out potential suppliers thoroughly.

“There are huge differences in different companies. Make sure that you’re getting someone who is going to install it properly,” says the Wilcox, Neb., no-tiller and strip-tiller. “I know there are some budget brands coming online, so you have to be careful about it.”

On the design of the drip tape, a farmer may need pressure-compensated tape if there’s too much flow. And a water test should be done to make sure extra filters aren’t needed to run the system properly.

“If you’re not getting that out of a salesman, then stay away from them,” Lundeen says. “I’ve checked out other brands, and if you look at them up close, there can be some big differences.

“With some, you can see seams, or they’re using different nozzles. Make sure you’re getting the entire package.”

Lundeen also believes farmers are better off having someone design the system, taking into account the slopes and topographical features so the system will drain and flush properly.

Laying the system with RTK guidance allows farmers to have the exact location of the tape mapped.

“A lot of people ask me if you can do any kind of tillage if it’s necessary, or will it tear up the tape? Since I’m growing corn on corn, I try not to set the strip-till units too deep and I’ve gotten by fine,” Lundeen says.

“The No. 1 key is to hook up with the right companies or dealers with reputable components,” Bisconer adds. “Look at the warranty policies, support and specs in addition to the price.”
Greving says, “We also reduced water applications by 40% compared to our pivots.”

Greving points out that if he was only allocated 9 inches of water a year, as is the case already in some parts of his state, he would have to irrigate with drip irrigation, “because you can’t grow a crop with 9 inches of water using pivots or gravity.”

Don Anthony of Lexington, Neb., who farms 1,300 acres in the Platte Valley in Nebraska, uses two-thirds to three-fourths the water and energy with drip irrigation compared to center pivots. But he takes the utilization of drip irrigation a step further.

It takes 3 days for his pivots to complete an irrigation cycle, and more than 2 weeks for his gravity fields. But with drip irrigation, he can apply a small amount of water quickly and avoid plant stress.

“I can wait longer for the rain and apply a short irrigation quickly if the rain doesn’t come,” he says. “If rain does come, I’ve saved myself an irrigation cycle.”

Drip irrigation has allowed DuPont Pioneer researchers to deliver precisely metered levels of nitrogen at any crop stage to create accurate comparisons of corn germplasm for nitrogen-use efficiency. Researchers are investigating the physiological response of corn to novel nitrogen timings and amounts as a means of increasing yields.

For example, in preliminary studies, Pioneer researchers have found that delivering pulses of nitrogen via the drip system to corn in a 2-week window around pollination can significantly increase yield.

Pioneer notes that no-tiller David Hula used a strategically timed (tasseling and silking) hand application of nitrogen at 100 pounds per acre that was instrumental to him winning the 2011 National Corn Growers Association corn yield contest with 429 bushels an acre.

Hula and Pioneer researchers estimated this strategy added 40 to 50 bushels an acre from that field.

At the same time, Bisconer says, there are opportunities in savings in water, fertilizer and energy use and labor expenses, and possibly with disease suppression.

Bisconer also sees an advantage with drip irrigation as it relates to harvest, because farmers could irrigate right up to the point they pick their crops, rather than waiting on a dry-down period that might be required with sprinkler or gravity irrigation.

“Sometimes drip irrigation saves crops,” she says. “It might spell the difference between getting a crop or not.”

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**A Resource For Comparing SDI And Center Pivot Irrigation**

Kansas State University research and Extension personnel have developed a free Microsoft Excel spreadsheet template for making economic comparisons of center-pivot and drip irrigation.

Input factors for the calculator include field size and shape, irrigation system costs, system life, production costs for each system, etc. The spreadsheet also provides sensitivity analysis for key factors.

This spreadsheet can be downloaded at [http://www.ksre.ksu.edu/sdi/](http://www.ksre.ksu.edu/sdi/)

Some key observations from using the calculator:

- Baseline analysis assumes a 25% water savings for an SDI system vs. center-pivot system.
- Center-pivot systems have an economic advantage over drip irrigation for large fields.
- Drip irrigation is favored over center pivot for small and irregularly shaped fields.
- Higher corn yields and corn prices favor SDI economics.
- Increasing longevity of SDI is the most important factor necessary for SDI to become economically competitive with center-pivot systems.
A No-Tiller’s Story

Wilcox, Neb., no-tiller Joe Lundeen is taking a more gradual approach with his 4,000-acre farm. Lundeen strip-tills corn-on-corn acres and no-tills soybeans with his father, brother and uncle.

Nearly all of the farm ground is irrigated, and they receive about 22 inches of rain a year. They have an allocation of 9 inches of water that can be pumped each year from the Ogallala aquifer.

The Lundeens are being regulated on the southern tier of their farm on how much irrigation water they can pump.

That was the motivating force behind going to no-till after ridge-tilling crops, and Lundeen thinks they’re saving at least a couple of inches of water a year in the soil.

In 2006, they installed Toro’s drip-irrigation system on a 40-acre field that’s been planted to corn. They were flood-irrigating the field, but had a low spot where water wouldn’t run through. Putting in a linear pivot wasn’t practical.

“Efficiency was a big factor, too,” Lundeen says. “I still have some flood irrigation adjacent to that field. Over the years, I’ve been using about half the water with drip irrigation compared to flood irrigation.

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