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Subsurface drip irrigation

Is it right for your operation?

Some farmers in Nebraska have installed and others are considering installing subsurface drip irrigation for row crops like corn and soybean. Consider the system's advantages and disadvantages when deciding if this method is the right choice for your operation.

Unlike other irrigation systems, subsurface drip applies water directly to the crop root zone using buried polyethylene drip tapes that come in various diameters and thicknesses. The smaller diameter tapes are used for short lengths. As the run length increases, larger diameter tapes are needed. The thickness of the tape wall is directly related to its durability. Thin tapes are mainly used for temporary installations such as surface drip irrigation of high value crops. The thicker tapes are used for permanent installations. The cost of the tape is directly related to both diameter and thickness.

Small holes called emitters are spaced every 8 to 24 inches along the length of the drip tape. When the tape is pressurized, water passes through the emitters to the soil, drop by drop. The movement and wetting pattern will depend on the soil's physical characteristics. For instance, in a heavy soil water will tend to move laterally and upward to a greater degree compared to a sandy soil where it tends to move downward. The amount of water that can be delivered through the system depends on tape diameter and spacing, operating pressure, and emitter spacing, size, and design. You can choose from a

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Daily precipitation and soil temperature updates at cropwatch.unl.edu

Daily updates of precipitation and soil temperature data have been greatly expanded on the CropWatch web site. While we formerly featured data for fewer than 20 sites, we now offer information for more than 90 sites as well as color keyed maps illustrating precipitation and soil temperature data across the state. This information is being provided by the High Plains Climate Center, housed at the University of Nebraska, and is being facilitated by Al Dutcher, state climatologist.

Precipitation data and percent of normal precipitation is provided for all of the sites, for these periods: the last 7 days; April 1 to current (Continued on page 75)
Management tips
May 3-17

♦ Scout corn fields regularly starting at emergence for signs of cutworm injury. Small cutworms may cause small holes in leaves; larger cutworms may cut a plant at soil level. Postemergence treatments are recommended if 5% cut plants are found.

♦ Since we've had some rain, it's a good time to catch up on that record keeping, such as what was planted where, herbicides used, etc.

♦ The Panhandle continues to be hit by below normal precipitation that is affecting just about all phases of crop production. One option that may be available to producers to help reduce stress on pastures is to graze out winter wheat production. Wheat has grown a considerable amount on stored moisture and while it will need significant rainfall to produce a grain crop. It may provide enough forage to delay turning cattle into spring pastures with limited growth that could be rapidly over grazed. Producers will need to weigh carefully other feed costs and the value of the wheat as grain.

Field updates

Gary Zoubek, Extension Educator in York County: Producers made great progress this past week with planting! The field conditions were great in ridge-till fields, and with over an inch of rain over the weekend, hopefully the crops will emerge well.

Terry Hejny, Extension Educator in Fillmore County: Last Saturday, the county received from 1.20 to 1.50 inches of rain, stopping planting operations. It looks like 75%-80% of the corn is planted. Winter wheat in the county looks above average to good. Pastures are beginning to rebound due to the moisture received the past couple of weeks. Alfalfa looks above average to good.

Ralph Anderson, Extension Educator in Buffalo County: What a difference a rain makes! While we are still plenty short on subsoil moisture and any reserve, we did receive enough moisture to germinate most of the corn that is in the ground. It also will help activate herbicides, although they may not be as effective as we would like. In some areas, planting is ahead of last year. In other areas, farmers were waiting for the rain before they started planting. Wheat and alfalfa are looking good but pastures are slow to greenup. In general, soils are warmer than normal, by as much as 10 degrees. Dry soil may warm up fast, but will cool rapidly when air temperatures fall and rain comes.

Terry Gompert, Extension Educator in Knox County: Grazing oats has gained some interest in northeast Nebraska. If oats are grazed hard before jointing, many tillers will produce high value forage. If oats can be grazed to 2 to 3 inches prior to jointing and then left to rest for three or four weeks before regrazing, you'll be surprised at the forage production. With cereal crops, remember the old saying, "Graze it or lose it." This year, those who drilled oats seemed to do better than those who broadcast seed. I suspect some seed may have winter killed laying on the ground.

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variety of tapes to fit specific design requirements.

One of the main advantages of subsurface drip irrigation is that it has the potential to be the most efficient irrigation method available today. I stress the word potential because irrigation efficiency not only depends on the type of irrigation system, but also on its design and management.

Since the tapes are usually installed every other row, the system only wets a fraction of the soil, requiring less water and leaving space in the soil to store water from rainfall. Also, since the drip tapes are buried -- about 16-18 inches for corn -- the soil surface stays dry. A dry soil surface means that practically no irrigation water is lost from evaporation or runoff. In addition deep percolation losses can be eliminated. The only small inevitable water losses are those needed for flushing the drip tapes and filtering system. Therefore, subsurface drip irrigation can deliver water with an efficiency of 95% or higher. This means that for every inch of water that is pumped, 0.95 inch or more stays in the crop root zone. Because of the potential high efficiency of this system, it may be especially beneficial where water is limited. Water savings, however, should not be the only factor to consider when selecting an irrigation system.

Water savings

_How much water can be saved by switching to subsurface drip irrigation?_ Furrow irrigation efficiency is usually 65% or less. Assuming that the net seasonal irrigation requirement for corn is 15 inches (taking into account water inputs from rainfall and residual soil moisture), the furrow system would need to apply 23 inches while the subsurface drip system would need to apply 16 inches, a savings of 7 inches.

Changing from center pivot to subsurface drip irrigation does not provide significant water savings; however, switching to it from furrow irrigation does. The high initial cost and energy savings also need to be considered.

When compared to center pivot irrigation the water savings is not as dramatic. Assuming a center pivot with an irrigation efficiency of 90% and a net irrigation requirement of 15 inches, the producer would need to apply 16.7 inches, a difference of less than 1 inch.

Therefore, changing from center pivot to subsurface drip irrigation does not provide significant water savings; however, switching to it from furrow irrigation will result in significant water savings.

Subsurface drip irrigation can be automated for frequent applications of water, fertilizers, and other chemicals such as acids, chlorine or pesticides. Research has documented that spoon-feeding water and nutrients to vegetable crops can result in increased yields; however, the results for corn have not been as fully researched.

Keeping the soil surface dry

Because subsurface drip irrigation keeps the soil surface dry, seed germination may be a problem, especially in sandy soils, since water has difficulty moving up in the soil profile. Additionally, rodents like gophers may chew on the tapes and leaks can be difficult to repair since they require digging the tapes out.

Having the irrigation system underground and keeping the soil surface dry also means that farm equipment can enter the field during irrigation, and there is less
Soil is dug away to show an installed tape used for subsurface drip irrigation.

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potential for weed germination and growth. Subsurface drip irrigation adapts well to fields of any size and shape, unlike center pivots. However, it does not work well in rolling terrain.

Energy savings

Energy savings is another advantage of this irrigation method. Subsurface drip irrigation systems operate at low pressure and deliver small flow rates. Emitters usually require a pressure of 4 to 15 psi and flow rates of 0.16 to 1 gallon per hour. Less energy is required to achieve the low water pressure and a smaller pump than those used for either center pivot or furrow irrigation is needed to achieve the small flow rate.

Cost

The largest disadvantage of subsurface drip irrigation is its high initial cost, which varies from $600 to $1200 or more per acre, depending on field size and level of automation. In Nebraska, an average cost of $800 per acre is a good estimate. This includes the cost of installation, which is around $200 per acre. For a large field, the $800 cost of installing subsurface drip irrigation cannot compete with the cost of installing a center pivot, which costs about $400 per acre.

Economic comparisons of center pivots and subsurface drip irrigation conducted by Kansas State University researchers, however, showed that as fields get smaller, subsurface drip irrigation becomes more cost effective as compared to pivots. Determining the economic break-even point, however, is complicated since the analysis is sensitive to expected crop prices, value of the water saved, expected yield increases, field size, and the life expectancy of the system. Some of these factors are relatively uncertain. For instance, subsurface drip irrigation is a relatively new technology and the life expectancy of system components is unknown. There is a 12-year-old system in Colby, Kansas, where the drip tapes still look and function like new. There are even older systems in California. Design and maintenance of the system also will affect its life expectancy.

In general, center pivots make more economic sense for large areas. Subsurface drip irrigation could be a good alternative for small, odd-shaped fields, especially when irrigation water is limited. Future cost-share programs may make subsurface drip irrigation more economical as the need to save water increases and as concerns about the environmental impacts of irrigation becomes more important.

Aside from cost, it is critical that these systems be properly designed and maintained. Decisions made during the design phase cannot be reversed after system installation. Decisions like tape diameter, length, emitter diameter and spacing, lateral spacing, mainline diameter, type of filtration and injection systems, etc, need to be made by both the farmer and an experienced irrigation system designer. This is particularly important since the recovery value of an abandoned subsurface drip irrigation system is very low.

Clogging

Proper maintenance is absolutely necessary for these systems to be successful. The main problem with drip irrigation systems is emitter clogging. Since the emitters have very small diameters, they can be clogged by very small particles. And once emitters are clogged, there’s no easy way to unclog them.

Soil particles, chemical precipitates, and biological particles all can cause clogs. That’s why the filtra-

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The filtration system will block most soil particles, however some very small particles may still pass through and settle inside the tapes. These particles need to be eliminated by periodically flushing the system. This is why the design must include a good filtration system as well as a proper flushing system. This usually includes connecting the drip tapes to a PVC flush line at the end of the field.

Crop roots growing around the drip tapes also can plug emitters, especially when the soil is dry. Keeping the soil around the tape sufficiently wet and injecting chemicals to kill those roots can eliminate this problem. When water in the drip tapes is drained after irrigation, a negative pressure can be created inside the tapes. Under this negative pressure, soil particles from outside the tapes can be sucked in through the emitters. This can be avoided by adding air/vacuum release valves at strategic points in the system.

**NDEQ regulations**

Although one advantage of this system is that fertilizer and other chemicals can be applied with irrigation water, the producer needs to be aware of some legal issues involved. Before injecting any chemical, the producer will need a chemigation license from the Nebraska Department of Environmental Quality (NDEQ) and comply with all legal regulations. Regulations may even affect where a drip irrigation system can be installed. If you’re considering installing a system, contact the NDEQ to inquire about legal requirements.

**Summary**

All things considered, subsurface drip irrigation is a highly efficient system, which can be used to help improve the management of both irrigation water and crop nutrients. Because of economics, it has mainly been used to produce high value crops like vegetables and fruits, but its use in row crops is beginning to spread. Here in Nebraska, some farmers are irrigating small fields of row crops and are satisfied with the results. Other farmers have tried it and failed. Causes of failures include cutting corners on key system components, like filtration systems and flushing lines.

My advice for those considering subsurface drip irrigation is to get as much information as possible. Talk with farmers in your area who are already using the system. A good resource for technical information about subsurface drip irrigation is the Kansas State University Web site at www.oznet.ksu.edu/sdi. For further information you also can contact your local NRCS or Cooperative Extension office.

**Introducing Jose Payero**

Jose Payero, author of this week’s CropWatch feature on subsurface drip irrigation, is a water resources/irrigation engineer at the West Central Research and Extension Center near North Platte.

Payero, who joined the NU faculty at the WCREC in 2000, received his bachelor’s in agronomy from the Universidad Catolica Madre Y Maestra in the Dominican Republic in 1984, his master’s in agriculture-plant science from California State University in Fresno in 1987 and his doctorate in irrigation engineering from Utah State University in 1997. A native of the Dominican Republic, he was a professor at EARTH University, an international agricultural university in Costa Rica and a professor of irrigation and drainage at the Instituto Superior de Agricultura in the Dominican Republic, where he was also head of the university’s soil fertility testing lab.

His research interests are in irrigation water management, water quality, and direct measurement of evapotranspiration and other energy-balance components over crop canopies. He conducted research at the USDA Agricultural Research Service facilities at Kimberly, Idaho and at the Remote Sensing Service Lab at Utah State University.

Payero is married and has two daughters.

He can be reached through his office at the UNL West Central Research and Extension Center, 461 South University Drive, North Platte, NE 69101; by phone at (308)-532-3611, ext 160; by fax at (308)-532-3823 and by email at jpayero2@unl.edu

**Planting proceeds**

The USDA’s Nebraska Agricultural Statistics Service reported Monday that wheat condition remained steady with 9% rated very poor, 21% poor, 41% fair, 28% good, and 1% excellent. As of Monday, just 14% of the crop had jointed, well behind the average of 25% for this period.

Corn planting was 32% complete by Monday, well ahead of the 18% average. About 3% of the corn crop had emerged.
Changes now can have long-term impacts

Reduce weeds in pasture and range

Controlling weeds in range and pasture should be viewed as a long-term operation, guided by other aspects of your management. We tend to think of weed management in terms of selective herbicidal control on the spot as is typical in row crops. In pasture, many techniques can be used to “selectively” remove weeds; however, these should never replace good, sound management.

Weed infestations in pasture usually point to a management problem. Pastures are unique systems that do quite well when managed properly. Grazing livestock is a key component of pasture/range management. However, when overgrazing and abuse occur, favorable perennial forages are replaced by a host of invaders and/or exotic plants. When pastures are grazed, vegetative material is removed and openings are left in the grass canopy. When overgrazed, favorable forages are weakened and slow to regrow, providing a good opportunity for weeds to move in and establish.

Chemical control

There are several pros and cons to chemical control of weeds in pastures. For most broadleaf weeds, chemicals work quite well. Depending on the specific weed, either Ally, Tordon, Banvel, 2,4-D and/or combination herbicides such as Grazon, Curtail, Redeem, or Transline will control most infestations. Producers should remember that more than one application may be needed for complete control. Also, in pastures with legumes, such as clover, there is really no good way to selectively control broadleaf weeds without damaging the legumes. Spot treatments may provide acceptable control while reducing the amount of injury to desirable species.

Timing of weed control is also important. If annual weeds are present, including ragweed, sunflower, prostrate vervain, catchweed bedstraw, bee-balm and annual sage, control should occur early in the season before the plants are large and go on to produce seed. Perennials such as Canada thistle, hoary vervain, ironweed, goldenrod, and curly dock generally respond better to fall applications when the plant energy reserves are translocated down to the roots.

Specific rates for troublesome weeds can be found in the 2002 Guide for Weed Management for Nebraska (EC-130) available from your local University of Nebraska Cooperative Extension office.

Grazing

Perhaps no other management factor has as great an impact on the species composition of a pasture as grazing. When well managed, livestock can be very beneficial to the overall vigor and health of a pasture. Of course, when timed incorrectly or if the stocking rate is too heavy, livestock can be hard on pastures, leading to weed infestations.

Livestock, like all animals, have certain preferences for some plants. For instance, little bluestem may not be grazed readily but eastern gamagrass is very desirable to cattle. It does not take long to figure out which one will disappear first.

Good management will focus on redistributing livestock to minimize overuse of desirable forages.

Warm vs. cool-season pastures

Warm and cool-season grass forages are mixed in pastures throughout Nebraska. While this provides for ideal grazing schedules, this can make grassy weed management quite difficult. If cool-season grasses are a problem in a warm season pasture, remove cool-season grasses early in the spring before the warm season grasses break dormancy. Glyphosate does well here, provided the warm-season grasses are dormant. Remember, switch grass breaks dormancy about April 15.

Another technique is to heavily graze the cool-season forage in the spring and late summer, allowing the warm-season grasses to remain dominant. Fire has been used for centuries in early to mid spring. This is perhaps one of the most efficient management tools the producer can use. Burning pastures heavily infested with cool season grasses and woody plants in the spring will do a lot for the overall health of warm-season forages and provide some weed control. Heavy grazing also can work well to remove warm-season grasses from a cool-season pasture, provided the grazing occurs in mid summer.

Remember that range management should be based on integrated pest management. Livestock, herbicides, a working knowledge of plant ecology and common sense can be used to maintain pastures in a desirable stage. This balance is delicate and will not be maintained with improper management. The producer has a narrow window each year to implement changes that will have an impact for several years. Weeds in a pasture are a signal of management problems. While controlling them is important, be sure to understand what’s contributing to their development so management can be adjusted accordingly.

Brady Kappler, Extension Educator – Weed Science

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Revised weather data
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date; January 1 to current date, and September 1 to current date. Data is organized by districts and includes district and state averages for each of the categories.

Precipitation maps illustrate amounts since April 1; since January 1; since September 1; during the last 30 days; during the last 60 days and percent of normal precipitation since September 1 and for the last 60 days. Precipitation data is available at http://cit-dev.unl.edu/cropWatch/precipitation.html

Similar soil temperature data is available for more than 30 sites. Color-coded maps are used to illustrate the data. Soil temperature resources can be found at http://cit-dev.unl.edu/cropWatch/soilTemperature.html

The precipitation and soil temperature data are available as links from the main CropWatch weather page at http://cropwatch.unl.edu/weather.

In mid to late May we will add evapotranspiration and growing degree day data to the main CropWatch weather page. We hope to be able to include data for several crops not previously supported, including potatoes, dry beans, and sugar beets.

The University of Nebraska provides weather and climate resources to help you plan and manage accordingly. The High Plains Climate Center offers a number of resources at http://hpcc.unl.edu and the National Drought Monitor is available at http://drought.unl.edu/dm/monitor.html.

If you have weather related Web sites which you find particularly useful and would like to recommend, please do. I’ll be updating the weather links soon and would welcome your suggestions. Just email them to Lisa Jasa at ljasa1@unl.edu.

Early season weed control needed in sorghum

Grain sorghum is a crop that grows best during the warm part of the growing season. Sorghum planted before May 20 grows more slowly than many annual weeds. Fortunately a number of herbicides are available to control weeds during this vulnerable portion of sorghum’s growth.

Many of the preemergence herbicides used in corn are also registered for sorghum and can be used in no-till as well as conventional till systems. The list includes Aatrex/atrazine, Bicep II Magnum/Lite, Dual II Magnum, Bullet, Frontier, Outlook, Guardsman/Max, Micro-Tech, Lariat, and LeadOff. Use rates in corn and sorghum are similar except for Bicep II Magnum where the rate for sorghum is less than that for corn. All of these herbicides except for Aatrex/atrazine require safened seed to prevent herbicide injury.

Aatrex/atrazine, the least expensive of these herbicides, provides fair control of foxtails but poor control of most other grasses. It provides fair control of large seeded broadleaf weeds and good control of small seeded broadleaf weeds. Dual II Magnum, Frontier, Outlook, and Micro-Tech provide good control of many annual grasses and small seeded broadleaf weeds but poor control of large seeded broadleaf weeds. The combination products containing both a grass herbicide and atrazine, Bicep II Magnum/Lite, Bullet, and Guardsman/Max, provide good control of many annual grasses and small seeded broadleaf weeds, and fair control of large seeded broadleaf weeds.

All of these herbicides require a good rain after application or mechanical incorporation to ensure good performance. Even with a good rain large seeded broadleaf weeds often require additional control. Several effective postemergence herbicides are available for broadleaf control and one, Paramount, provides postemergence grass control in sorghum.

Alex Martin
Extension Weed Specialist

Scouting and pest management resources

A number of resources are available to help with pest identification, scouting and treatment in field crops. Many are available in print as well as on the web. Check with your local Cooperative Extension office for print copies.

UNL web sites with identification, scouting and treatment recommendations include:

• Plant Disease Central at pdc.unl.edu;
• Department of Entomology Web site at entomology.unl.edu and
• 2002 Guide for Weed Management in Nebraska, available as a pdf document at http://www.ianr.unl.edu/pubs/fieldcrops/ec130.htm

Lisa Jasa
CropWatch Editor
Weed Science Field Days set for June

The itinerary has been set for the 2002 University of Nebraska Weed Science Field Days, formerly known as the "Weed Science Tour."

The name of the event was changed to better reflect a new schedule. This year not all the tour will occur in the same week, allowing participants to have a better opportunity to see even more demonstrations at each site due to environmental differences between locations. This year the "tour" will begin at the South Central Research and Extension Center near Clay Center. These field days will provide a hands-on look at university herbicide research trials. While most participants are from the agricultural chemical industry, the tour is free and open to the public. Individuals may attend all or part of it. The itinerary is as follows:

Tuesday — June 18
9:00 a.m., Clay Center, South Central Research and Extension Center

Wednesday — June 19
8:30 a.m., North Platte, West Central Research and Extension Center
3:30 p.m., Sidney, High Plains Agricultural Laboratory

Thursday — June 20
8:30 a.m. (MDT), Scottsbluff, Panhandle Research and Extension Center

Tuesday – June 25
9:00 a.m., Lincoln, Havelock Research Farm

Wednesday – June 26
1:00 p.m., Concord, Haskell Agricultural Laboratory

Brady Kappler
Weed Science Educator

Alfalfa weevil scouting

This map shows accumulated growing degree days base 48 as of April 28. Most of the state has passed the 350 GDD threshold and scouting should be underway for alfalfa weevils. Keith Jarvi, Extension entomologist at the Northeast REC, reminds producers to not let down their guard. Recent cool weather has slowed insect development and their appearance may be a little delayed in some areas, leading to an unwelcome surprise if scouting stops short. (Map prepared by Al Dutcher, state climatologist, NU School of Natural Resource Sciences.)

With dry conditions the norm, delay grazing pastures

Early spring is the most difficult time of the year to correctly graze pastures, especially since your decisions now can affect pasture production for the remainder of the year.

In most years, grazing cool-season grasses in spring should be easy. There is lots of grass and the animals do well. In fact, most springs we have so much grass that much of it goes to seed and is wasted. To avoid this, I usually recommend starting to graze early to keep up with grass growth.

However, when subsoils start out as dry as they are this spring, early grazing will lower grass yields and yearlong carrying capacity. If your subsoils are dry underneath your pastures this spring, turn cattle out to grass about two weeks later than normal. This should increase forage production on those pastures from 10% to 20% compared to starting at the normal turnout date.

Don’t let some extra early spring green-up fool you into starting too early. Many pastures in eastern Nebraska look like they should already be grazed, but that might not be the best practice in the long run. This year, with the dry soils, let the calendar be your guide. If you usually turn cattle out about May 1, this year wait until May 15, feeding carryover hay if necessary. Then quickly move animals through all your pastures once. When you start your second rotation, slow down the movement so each paddock has at least six weeks to recover before the third pass. After that, let rainfall and grass growth be your guide.

Bruce Anderson
Extension Forage Specialist