SDI Considerations for North Carolina Growers and Producers

NC STATE EXTENSION

Subsurface Drip Irrigation

Subsurface drip irrigation (SDI) is the practice of installing drip irrigation (low flow-rate emitters operating at low pressures) below the ground. SDI may be used below planting and tillage operations even in standard row-crop production systems.

SDI's advantages include:

- delivering water near the roots of crops,
- minimizing water losses due to evaporation,
- installation possible in fields with irregular shapes,
- spoon-feeding needed nutrients especially important where rainfall can leach significant nutrients, and
- establishing zones of irrigation based on limited water supplies and differing water needs of soils and crops.

This factsheet provides a brief introduction to the site selection, design and installation, and management of subsurface drip irrigation (SDI) in North Carolina. It is not intended to give all the information necessary for a complete and functional system. For more information, contact your county Cooperative Extension center or visit Irrigation Resources.

SDI has been used in arid and semi-arid regions for many years. Producers who wish to use a SDI system in a humid region like North Carolina must deal with significant rainfall and temporary saturated soil conditions that are not typical of arid and semi-arid regions. Site selection, soils, tillage requirements, and management of moisture-related problems (algae growth in the system, soil stability, excess soil water, pests, etc.) may also be quite different from those in arid regions.

Initial Costs

SDI systems are not cheap to design, install, or maintain, especially if you must also develop a water supply. Carefully consider the potential profits for row or other crops before deciding to invest in SDI. Some SDI systems have been tested and are still functioning after 10 years of use. However,

an increased level of management and care is required if a system is to be in place and functional for a long period of time.

Water Supply: Quantity and Quality

You will need enough water to meet the required pumping rates for the system, and to meet the needs of the crop(s) for the irrigation season. Your water supply may be groundwater, surface water, or a reuse source. Base pumping capabilities (flow rate) on the peak water demand for the highest water use crop expected to be grown over the system, and the flushing requirements of the filtration system (to remove any deposited particulate material).

The water supply should be free of particulates and biological materials (like algae). Water that is slightly acidic is preferred since more alkaline water tends to precipitate minerals within the irrigation system.

Basic filtering is usually required for any water supply used in SDI systems. If the water supply has particulates, biological material, or is alkaline, advanced filtering or even chemical treatment may be required to keep the drip emitters from clogging. SDI systems can be designed for wastewater disposal/treatment; however, you will need to include proper filtration and chemical injection treatment to prevent emitter plugging.

Energy Source

Irrigation systems require an energy source to pump water and maintain water pressure. Based on availability, cost, and accessibility on your farm, you will need to consider an electrical, diesel, natural gas, or another energy source. Keep in mind that SDI systems with operational controllers may be less desirable if you will use a fossil fuel-based power system because the controllers may not be “on” all the time. Like other drip irrigation systems, SDI systems can be “zoned” to reduce the pumping rate, pump and power unit size, and energy requirements. Zoning will reduce the rate of energy use, however, the time of operation will be extended.

Soil Limitations

SDI systems do not have strict soil restrictions. Be aware of the position of a plow pan or other semi-impervious zone above or beside the emitters. While there is some potential benefit if a semi-impervious zone below the emitters reduces potential deep seepage and encourages lateral movement of water, an impervious zone in the wrong position will prevent water from getting to the plant roots.

Soils that are prone to develop plow pans can benefit from SDI and reduced (or no) tillage systems. Cropping operations that require periodic soil turning can quickly destroy a shallow SDI system, and soils that typically require deep subsoiling are less amenable to subsurface drip irrigation. If you

want to use SDI in areas where soils must be deep subsoiled, extensively map the depth and location of the SDI laterals to prevent future damage.

Very sandy soils have a limited capillary (upwards) movement of water from the emitters, which may make it difficult to provide enough water during germination or plant establishment. A supplemental irrigation system may be necessary to assure plant establishment if rainfall is insufficient during the plant establishment period.

Surface Slop Limitations

If the topography of your farm is complicated, you may need an SDI system with pressure-compensating emitters. These emitters are designed to discharge a similar flow rate as the elevation and slope changes. However, SDI systems require a relatively low operating pressure and significant changes in slope can affect the available pressure to different parts of the field (high and low pressure). High pressures can rupture driplines, while low pressure can reduce the water output across a portion of the field.

Field Layout Advantage

SDI systems adapt more easily to different field sizes and shapes when compared to other types of irrigation systems. Field areas are not always circular (center pivot) or rectangular (large gun). Since you can control the areas you irrigate with SDI, you have the option to irrigate only the best soils.

Potential Disadvantages

Since most SDI components are permanent in the field, it may not be economical to install SDI on leased land.

Costs for SDI can be high, especially if driplines are placed below each row. Care must be taken to maintain a consistent depth, spacing, and location to reduce the potential for damage from mechanical operations. The depth of driplines required for crops that have their fruit below the ground (such as peanut and sweetpotato) may be too deep for effective early season irrigation.

Other Design and Installation Considerations

Figure 1 shows the essential components of a well-designed SDI system. Care and maintenance of all these components are essential for long-term, reliable operation. Locate operational system components in an easily accessible area. Locate any above ground components (such as

air/vacuum vents and flushing risers) away from potential traffic. Install air relief valves at all high points in the system. Make sure your design includes good flushing capabilities for laterals and mainlines. If your SDI system is going to last, flushing capabilities are absolutely essential.

There are a number of critical design steps for creating an effective SDI system. You will need to answer the following questions before an adequate SDI system can be designed for a particular field.

- Do I grow the same crop each year, or will I rotate crops?
- Do all crops I will be growing have similar water use characteristics?
- Will the entire field be planted, or will the field be divided into smaller areas with different crops?
- Does this area grade from lighter soils (sands) to heavier soils (loams and clays)?
- Will field crops (such as wheat or soybeans) be rotated with row crops?
- Is subsoiling part of the production system?
- Are nutrient applications a critical part of my production system?
- If I am currently using an irrigation system that is not time-intensive, am I willing to spend more time maintaining and operating an irrigation system like SDI? Do I have a labor force that is willing and able to work with a system that requires more care and effort?

Each of the above questions generates a different set of design parameters from water supply to pumping requirements, location of components, depth of installation, spacing of drip laterals, automation requirements, etc. You must get input from trained personnel with SDI experience if you want your system to perform satisfactorily for any length of time.

Proper installation is also critical. Cutting corners by using cheaper materials and installation equipment, and selecting installers who are not as experienced will not save you money in the long run. If the design does not take into account specific details of the field site, consult the designer about appropriate modifications. If connectors or other components are substituted due to availability issues, you need to get assurance of the lifespan of these replacement components. Plan your system on paper, and mark proper field layout prior to any installation. Use the proper equipment to ensure depth precision. Finally, permanently mark buried lines after installation.

Timing of installation is one of the most critical factors in humid areas. The soil cannot be too dry or too wet. Installation of an SDI system is similar to a chiseling operation. If the soil moisture content is not acceptable for chiseling, it is likely not acceptable for drip installation. Fall is usually the best time for drip installation due to drier conditions (normally). There will also be sufficient time for the soil to settle prior to spring planting.

If you are planning to install your own SDI system, read other publications in the Subsurface Drip Irrigation series, check other resource materials, visit with your local irrigation expert, and talk with other producers with SDI experience. Your Cooperative Extension agent, NRCS personnel, and

irrigation dealers can help provide recommendations and information.

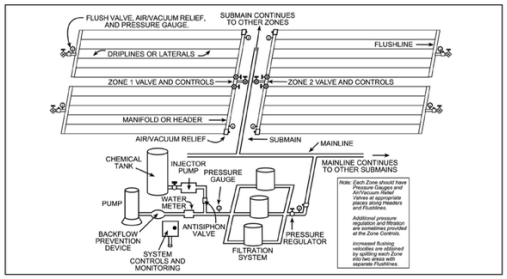

Figure 1. Typical Components of a Subsurface Drip Irrigation System. Mainline, submains, headers, and driplines are below ground. Figure courtesy of Kansas State University.

Other Management Considerations

Efficient water use should be your goal regardless of your irrigation system. Choose an irrigation scheduling technique that takes actual rainfall and the need for irrigation into account. Techniques vary, but the best one for you is one you will use.

You could follow the weather reports, use equipment to measure soil water, or use another approach to determine crop water needs. Since SDI applies water below the ground, soil water sensors are a good choice. Placement of such sensors is critical to ensure proper measurement of the soil moisture conditions in the plant root zone. While SDI systems are not normally operated at a fixed time of day, you may want to operate the system when local energy rates are lower. Choose operating times that also fit your management interest and capability.

You may use SDI to deliver chemicals (called chemigation), to control rodents and insects, to prevent roots from intruding into drip emitters, to dissolve chemical precipitates; or to deliver plant nutrients to the root zone of crops (called fertigation). Always follow manufacturers' labels to ensure effective application, proper use of the chemical, and protection of the SDI system. The types of chemicals required for different situations should be understood from the beginning. SDI can deliver fertilizer at a low rate over a long period. This reduces the potential for leaching losses (which can be a major problem in North Carolina) and provides plants with the right amount of fertilizer when it is needed.

Preventative maintenance is a key to preserving your SDI system's effectiveness. Once a problem develops, it is often impossible to correct, especially if the problem is associated with buried dripline. Test the quality of the water supply, routinely flush and clean the system (chlorination or other treatment), and continuously monitor system flow and pressure. Be aware that source water quality can change during the season and over years, so periodic testing is essential.

Components required to monitor an SDI system include a flow meter and pressure gauges. Maintain good records of pressures and flow rates for each zone. Without such records, you may not be able to figure out if a problem exists. Decreased pressures and higher flow rates may indicate leaks in the irrigation system. Increased pressure and lower flow rates may indicate plugged emitters.

Conclusion

SDI is a relatively new technology in North Carolina but a great deal of research and development support the use of such systems. If you are considering SDI for your farm operation, make sure you understand the site, system, and management requirements to ensure that your system will be effective, efficient, and provide a good return for your money.

For more information, see other titles in the Subsurface Drip Irrigation series.

- Site Selection for SDI Systems in North Carolina
- Design and Installation of SDI Systems in North Carolina
- Critical Management Issues for SDI in North Carolina

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