Agronomic Spotlight

Seminis grow forward

Water Management Using Drip Irrigation

- » Drip irrigation systems efficiently deliver water to the root zone of a crop with little water loss.
- » Drip systems are adaptable for use in fields with diverse shapes and topographies.
- » Soil texture and crop water requirements are used to design layouts for optimal water management.

In drip irrigation systems, water is applied through plastic tubes or drip-tapes that have small holes (emitters) spaced at regular intervals that allow the water to seep into the soil. With high application efficiency levels (80 to 95%), drip systems are being used increasingly to manage when, where, and how much water is applied to crops.[1]

Advantages of Drip Irrigation

Drip irrigation has several advantages over surface and overhead forms of irrigation. Drip systems can reduce water use by 50% as compared to sprinkler irrigation, and the lower pressure requirements can result in reduced pumping costs.[4,5] Yields are often higher in cropping systems using drip irrigation as a result of improved water management and reduced disease and weed pressure. The wetting of foliage that occurs with sprinkler irrigation can result in the spread of certain plant pathogens and favor disease development. This is not an issue with drip irrigation, and drier plant canopies can help improve aspects relating to food safety concerns.[2]

Drip systems have high water use efficiency levels because water is applied directly to the root zone and not to non-productive areas such as spaces between rows. A smaller area of the soil surface is wetted resulting in lower surface evaporation and usually no surface runoff. This also results in less soil erosion and nutrient leaching. Because the areas between the rows stay dry, field operations, such as harvesting, can take place even during periods of irrigation.[1,3]

Drip systems are very adaptable. They can be used in fields with uneven topography and in unusually shaped fields. Drip systems can also be used to deliver nutrients (fertigation) and pesticides (chemigation) to the crop during the season without disrupting root systems or damaging foliage. In some cases drip-tape and plastic mulch are left in place and reused for one or more following crops (e.g. cucumber following tomato).

Disadvantages of Drip Systems

The disadvantages of drip systems include a high initial investment ($1,200 to $2,000 per acre) and a higher degree of skill and management than are required with some other irrigation systems. Drip systems need to be monitored regularly for damage, clogs, and leaks so that repairs can be made quickly. With temporary drip installations (common with most vegetable crops) the drip tape needs to be removed at the end of the season, resulting in costs of removal and issues with disposal of the used tape.[1,2,3]

Drip systems require a higher level of water quality than other irrigation systems. Clean water within a certain range of pH and mineral content is needed to minimize problems with clogged emitters. Multiple filtration systems may be needed to adequately clean the water, and periodic acid and chlorine flushes may be needed to eliminate problems with mineral (iron) deposits and the growth of bacteria and algae that can clog emitters.[1,3] Because water distribution is restricted to the root zone, salt accumulation can become a problem in some areas, depending on water quality and the occurrence of natural rainfall.[2]

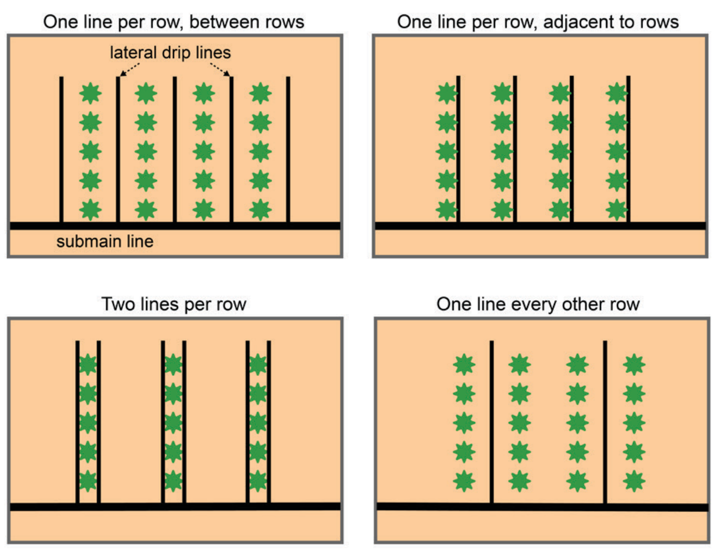

Figure 1. Different layouts for lateral drip lines relative to crop rows.

Drip System Designs and Layouts

The uniformity of water application is important to maximize crop growth and water use efficiency. Uniformity is affected by differences in pressure over the system. Drip systems typically operate at pressures between 8 and 12 psi, and pressure variations as low as 2 psi can substantially reduce the uniformity of application. Tape splicing, plugged emitters,

(Continued on page 2)

Water Management Using Drip Irrigation

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the use of tapes with different flow rates, and sloped fields all affect the uniformity of water application.[4] The use of drip tape with pressure-compensating emitters and dividing fields into zones of irrigation can minimize some of these problems.

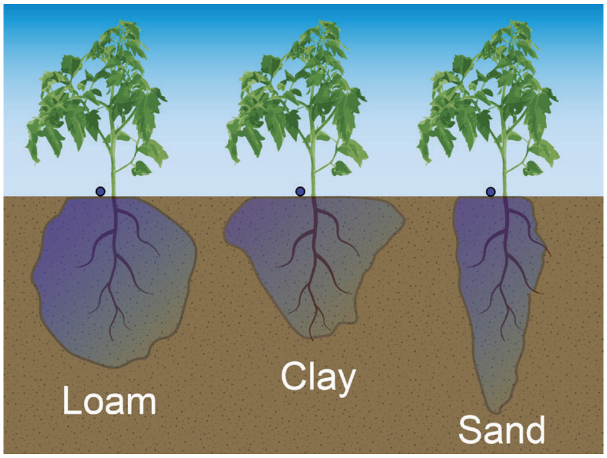

Figure 2. Water penetration profiles vary with soil texture.

Drip line arrangement. One variable to consider when laying out a drip system is the arrangement of drip lines within the planting. There can be one drip line for every two rows (every other row), one line per row, or two lines per row (Figure 1). The distance of the drip line from the plant row can also vary, with spacings of 6, 12, and 24 inches being most common. The number of lines used depends on crop water demands, soil properties, economics, and grower expertise and preferences.[1] Spacing choices also involve compromises between optimal water distribution and the cost of the system.[5] At least one line per row provides optimal water distribution, especially in sandy soils, but one line every other row can provide adequate water delivery at a lower cost on heavier soils with good horizontal water dispersal. In sandy soils, water moves down through the soil profile much faster than it moves horizontally, requiring a closer spacing of drip lines. In clay soils, water may move laterally faster than it moves downward, and wider spacing of lines will be adequate and may encourage deeper root growth (Figure 2).[5] Two lines per row can be beneficial for widely-spaced, high-demand crops, such as watermelon, and for crops grown on sandy soils.[1,5] Placing drip lines close to the crop row usually results in higher soil moisture levels in the top portion of the root zone, but this does not always result in higher yield and product quality, as placing the lines further from the row can encourage deeper root growth.[6]

Buried vs. surface line placement. Drip lines can be placed on the surface of the soil (planting bed) or buried below the soil surface. Surfaced placement can be easier and allows for easy inspection, maintenance, repositioning, and removal of lines at the end of the season. However, drip lines on the soil surface tend to move with the wind and are more prone to damage by animals, equipment, and foot-traffic. Lines can be buried 1 to 3 inches below the surface between plant rows or below shallow-rooted crops (onions). Placement at depths of 6 to 12 inches can be used for deep-rooted crops, and depths of up to 18 inches are used for permanent subsurface drip irrigation (SDI) systems.[2,3,7] Buried lines will not move, and they are better protected from damage. However, maintenance and removal are more difficult and expensive. Subsurface drip line systems also have the advantage that the soil surface is not wetted, eliminating water loss through evaporation, and water dispersal is often more uniform with subsurface systems.

Mulched vs. bare-ground irrigation. The evaporation rate from plastic-mulched soil can be half that of non-mulched soil. However, the growth rate of plants in mulched-bed systems can be faster than plants growing in bare soil, and the larger plants will use more water per unit area. Even so, the overall amount of water used per unit of production will be less in a mulched system.[8] Opaque plastic mulches also suppress weed growth and reduce the use of water by weed plants, further improving the water use efficiency.[4] However, plastic mulches inhibit rain-water from reaching the root zone, and in many cases, rainfall does not contribute greatly to the crop water requirements in plasticulture systems.[9]

Sources:

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Websites verified 2/21/2019

For additional agronomic information, please contact your local seed representative.