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# Drip Irrigation: An Introduction

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## Why consider drip irrigation?

Drip irrigation can help you use water efficiently. A well-designed drip irrigation system loses practically no water to runoff, deep percolation, or evaporation. Irrigation scheduling can be managed precisely to meet crop demands, holding the promise of increased yield and quality.

Growers and irrigation professionals often refer to "subsurface drip irrigation," or SDI. When the drip tube is buried below the soil surface, it is less vulnerable to damage during cultivation or weeding. With SDI, water use efficiency is maximized because there is even less evaporation or runoff.

Drip irrigation reduces water contact with crop leaves, stems, and fruit. Thus, conditions might be less favorable for disease development.

Agricultural chemicals can be applied more efficiently with drip irrigation. Since only the crop root zone is irrigated, nitrogen already in the soil is less subject to leaching losses, and applied fertilizer N can be used more efficiently. In the case of insecticides, less product might be needed. Make sure the insecticide is labeled for application through drip irrigation.

Additional advantages of drip irrigation include:

- Drip systems are adaptable to oddly shaped fields or those with uneven topography. They also can work well where other irrigation systems are inefficient because parts of the field have excessive infiltration, water puddling, or runoff.
- Drip irrigation can be helpful if water is scarce or expensive. Because evaporation, runoff, and deep percolation are reduced, and irrigation uniformity is improved, it is not necessary to "overwater" parts of a field to adequately irrigate the more difficult parts.
- Precise application of nutrients is possible using drip irrigation. Fertilizer costs and nitrate losses can be reduced. Nutrient applications can be better timed to meet plants' needs.
- Wheel rows can be kept dry enough to allow tractor operations at any time. Timely application of herbicides, insecticides, and fungicides is possible.
- Proven yield and quality responses to drip irrigation have been observed in onion, broccoli, cauliflower, lettuce, melon, and tomato.
- A drip irrigation system can be automated. For an example of automated drip irrigation, see the Malheur Experiment Station's 1998 onion drip irrigation trial results.

There are some disadvantages to drip irrigation. For example:

- Drip irrigation systems typically cost $500 to $1,200 per acre. Part of the cost is a capital investment useful for several years, and part is annual. Systems often are more elaborate than necessary. Growers new to drip irrigation might want to start with a simple system on a small acreage.
- Drip tape must be managed to avoid leaking or plugging. Drip emitters are easily plugged by silt or other particles not filtered out of the irrigation water. Emitter plugging also can be caused by algae growing in the tape or by chemical deposits at the emitter.
- You might need to redesign your weed control program. Drip irrigation might be unsatisfactory if herbicides need rainfall or sprinkler irrigation for activation. However, drip irrigation can enhance weed control by keeping much of the soil surface dry. Tape depth must be chosen carefully for compatibility with operations such as cultivation and weeding.
- Drip tape causes extra cleanup costs after harvest. You'll need to plan for disposal or reuse.

Despite all of drip irrigation's potential benefits, converting to drip irrigation can increase production costs, especially where an irrigation system already is in place. Ultimately, there must be an economic advantage to drip irrigation to make it worthwhile.

## Components and design

A wide range of components and system design options is available. The Digital Drip Directory lists equipment and suppliers. Drip tape varies greatly in its specifications, depending on the manufacturer and its use. The distribution system, valves, and pumps must match the supply requirements of the tape. Tape, depth of tape placement, distance between tapes, emitter spacing and flow, and irrigation management all must be chosen carefully based on crop water requirements and the soil's properties.

The wetting pattern of water in the soil from the drip irrigation tape must reach plant roots. Emitter spacing depends on the crop root system and soil properties. Seedling plants such as onions have relatively small root systems, especially early in the season.

Design must take into account the effect of the land's contour on pressure and flow requirements. Plan for water distribution uniformity by carefully considering the tape, irrigation lengths, topography, and the need for periodic flushing of the tape. Design vacuum relief valves into the system.

Consider power and water source limitations. Have water analyzed by a laboratory that is qualified to evaluate emitter plugging hazards. Water quality might create limitations and increase system costs. Filters must be able to handle worst-case scenarios.

Finally, be sure to include both injectors for chemigation and flow meters to confirm system performance.

## Management

### *Placement of the tape*

Plan for seed emergence. The drip tape must be close enough to the surface to germinate the seed if necessary, or a portable sprinkler system should be available. A tape tube 4 to 5 inches deep has successfully germinated onion seeds in silt loam soil. Tape at 12 inches failed to uniformly germinate onions.

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### Timing and rates

Irrigation water requirements are reduced because water can be applied much more efficiently with drip irrigation. For example, with furrow irrigation, typically at least 4 acre-feet/acre/year of water is applied to onion fields in the Treasure Valley of eastern Oregon and southwestern Idaho. Depending on the year, summer rainfall, and the soil, 14 to 28 acre-inches/acre of water has been needed to raise onions under drip irrigation in the Treasure Valley.

Applying more water than plants need will negate most of drip irrigation's benefits. The soil will be excessively wet, promoting disease, weed growth, and nitrate leaching.

To determine application rates, use measurements of soil water and estimates of crop water use (crop evapotranspiration, or "ETc"). Irrigate only to replace the soil moisture deficit in the top 12 inches of soil. It usually is not necessary to exceed ETc. Daily crop evapotranspiration estimates are available on the AgriMet Web site.

### Maintenance

Add chlorine or other chemicals to the drip line periodically to kill bacteria and algae. Acid might also be needed to dissolve calcium carbonates.

Filters must be managed and changed as needed. Even with filtration, drip tape must be flushed regularly. The frequency of flushing depends on the amount and kinds of sedimentation in the tape.

### Fertilizer

If irrigation is managed carefully to meet plant water needs, you'll need to apply less nitrogen fertilizer because nitrate leaching is reduced or nearly eliminated. For example, if fertilizer nitrogen applications are not reduced, an onion crop under drip irrigation will become excessively leafy. The excess foliage can inhibit curing and increase harvest costs and losses. Not only are total nitrogen requirements reduced with drip irrigation, but less nitrogen should be applied in each application.

Fertilizers containing sulfate, phosphate, calcium, or anhydrous or aqua ammonium can lead to solid chemical precipitation inside the drip tape, which can block emitters. Obtain chemical analyses of your irrigation water and seek competent technical advice before injecting fertilizers into drip tape.

### Other management factors

Root intrusion must be controlled for some crops. Rodents must be controlled, especially where drip tape is buried.

## For more information

### Web sites

AgriMet—daily crop evapotranspiration estimates (*mac1.pn.usbr.gov/agrimet/h2ouse.html*)

Digital Drip Directory—a list of equipment and suppliers (*www.microirrigationforum.com/new/directory*)

Drip irrigation discussion group—search features and discussions of all sorts of problems (*www.microirrigationforum.com*)

Drip Irrigation of Row Crops: What Is the State of the Art? Proceedings of the 4th Decennial Irrigation Symposium (*www.oznet.ksu.edu/sdi/Abstracts/Drip Irrigation of Row Crops.htm*)

How to find irrigation information on the Internet (*www.microirrigationforum.com/new/onthenet*)

Instrumentation for Soil Moisture Monitoring (*www.cropinfo.net/AnnualReports/1997/instrumentation.wq.html)*

Irrigation Scheduling (*www.cropinfo.net/irrigschedule.htm*)

Malheur Experiment Station onion drip irrigation trial results (*www.cropinfo.net/AnnualReports/1998/drip.onion.html*)

NRCS irrigation information links (*www.wcc.nrcs.usda.gov/nrcsirrig/irrigate_bookmark.htm*)

OSU Extension Service Publications and Videos catalog (*eesc.orst.edu*)

Kansas State University SDI Web site (*www.oznet.ksu.edu/sdi*)

### OSU Extension Service publications

*Chemigation in the Pacific Northwest,* PNW 360 (1992). $1.50

*Irrigation Management Practices Checklist for Oregon,* EM 8644 (1996). $2.25

*Irrigation Scheduling,* PNW 288 (Reprinted 1994). 50¢

*Simple Irrigation Scheduling Using the "Look and Feel" Method* (includes soil appearance cards in English and Spanish), EM 8716 (1998). $4.50

*Soil Water Monitoring and Measurement,* PNW 475 (1995). $1.00

*Strategies for Reducing Irrigation Water Use,* EM 8783 (2001). No charge

*Treating Water for Sediment Removal,* EM 8642 (Reprinted 1996). $1.50

*Western Oregon Irrigation Guides,* EM 8713 (Reprinted 2000). $5.50

To order copies of the above publications, send the complete title and series number, along with a check or money order for the amount listed (payable to Oregon State University), to Publication Orders, Extension & Station Communications, Oregon State University, 422 Kerr Administration, Corvallis, OR 97331-2119 (fax: 541-737-0817).

### Other publications

*Drip Irrigation for Row Crops.* 1994. Chanson, Schwankl, Grattan, and Prichard (University of California, Davis). Order from Cooperative Extension office, Department of LAWR, 113 Veihmeyer Hall, University of California, Davis, CA 95616 (phone 530-752-1130).

*B.C. Trickle Irrigation Manual.* 1999. Van der Gulik (B.C. Ministry of Agriculture and Food, Resource Management Branch). Order from Irrigation Association of British Columbia, 2300 Woodstock Drive, Abbotsford, B.C., Canada, V3G 2E5 (phone 604-859-8222).

*Fertigation.* 1995. Burt, O'Connor, and Ruehr (California Polytechnic State University). Order from The Irrigation Training and Research Center, California Polytechnic State University (Cal Poly), San Luis Obispo, CA 93407 (phone 805-756-2434).

*Microirrigation Management and Maintenance.* 1998. Hassan (Fresno, CA, Agro Industrial Management). The book is available from Farouk A. Hassan, Ph.D., irrigation and soils consultant, Agro Industrial Management, P.O. Box 5632, Fresno, CA 93755 (phone 209-224-1618).

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