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Using Drip Irrigation to Germinate Seed and Set Transplants: Techniques and Benefits

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Abstract. *In fruit and vegetable row crop production, many producers are successfully using drip irrigation systems to germinate seed and set transplants without the traditional use of sprinklers. This reduces runoff and decreases the water, labor, equipment and energy costs associated with sprinkler irrigation. Additional benefits of eliminating sprinkler irrigation include reduced weed germination, improved field accessibility, a reduced incidence of disease, and improved planting bed tilth. Food safety risks may be diminished as well since less moisture is available to harbor E. Coli, and farm safety may be improved since laborers no longer move heavy sprinkler pipe through terrain that is often rough, steep and/or muddy.*

The techniques to successfully set transplants and germinate seed without sprinklers are varied. Reiter Berry Farms in Watsonville, California credits soil prep, tape placement and irrigation scheduling as the keys to successfully setting strawberry transplants on consistently square beds with tops 27-29 inches wide. Naumann Ranch in Oxnard, California sets celery transplants without sprinklers by opening drip irrigation lines to newly transplanted rows after each round trip of the transplant machine has been completed, thus wetting beds quickly and supplying moisture to the transplants immediately. In the same geographic region, artichoke transplants are set with one line of drip tape. Standage Farms, Inc. in Vale, Oregon lays out drip tape after onion seeds are planted, and then irrigates with a 12 hour set to achieve the proper wetting pattern. Subsequent intervals between irrigations are determined by weather and sensors. Other growers are successfully germinating lettuce seed using similar bed shaping, tape placement and irrigation scheduling techniques.

A common technique to each case study is the use of closely spaced emitters to achieve desired wetting patterns. California Polytechnic State University, San Luis Obispo's Irrigation and Training Research Center (ITRC) reports that the right wetting pattern can increase crop quality, and that closely spaced emitters can reduce both purchase and operational costs vs. wider spaced emitters.

Thus, for optimal performance, closely spaced drip tape emitters are often the best choice to successfully set transplants and germinate seed without the use of sprinklers.

Key words. Irrigation, drip, drip irrigation, subsurface drip irrigation, SDI, drip tape, tape spacing, emitter spacing, wetting pattern, sprinkler irrigation, runoff, labor, energy, seed germination, transplant setting, strawberry, celery, lettuce, onion, artichoke, organic, weed germination, disease, farm safety, food safety.

Introduction

Many fruit and vegetable row crop growers use drip tape as their primary irrigation method in their growing system, but also use a secondary sprinkler system to germinate the seed or "set" the transplants at the beginning of the season. This secondary sprinkler system often wastes water where conditions are hilly or windy, and where plastic mulch is present, because irrigation water runs off and is not beneficially used. In some cases, this runoff water contaminates other water resources or erodes soil. Further, the use of a secondary sprinkler system requires additional expense for the sprinkler equipment itself, for the labor to move the pipe, and for the energy to achieve higher pumping pressures. For these reasons, innovative growers have developed ways to use the existing drip irrigation system to supply adequate germination and transplant moisture. The obvious benefits are reduced costs and improved usage of existing resources, but other benefits have been reported as well.

Growers cite significant cultural advantages to eliminating sprinkler use. First, weed germination is reduced since drip targets irrigation water to the planting bed while sprinklers wet the entire field, including furrows, field edges and roads. Thus, unwanted weeds are germinated with sprinklers that require cultivation, hand weeding and/or herbicide treatment. This is especially important in organic fields where expensive hand labor must be used to weed since herbicide use is prohibited. Second, the incidence of disease is reduced since the plant canopy remains dry and the air less humid. This has significantly reduced fungicide sprays and/or crop loss, and again is especially important in organic fields where fungicide use is prohibited. Third, field accessibility is improved since sprinkler pipe does not impede other cultural operations. Fourth, the planting bed remains soft and is not hardened or crusted over from the use of sprinklers. Fifth, food safety may be enhanced since less standing water is available to harbor E.Coli. And sixth, farm safety conditions may be improved since heavy sprinkler pipe is no longer moved by laborers through uneven terrain that is often steep and/or muddy.

The following discussion examines actual case studies of three growers who have successfully germinated seed and set transplants with their existing drip irrigation system. Their techniques are presented, along with the varied benefits. In addition, the use of drip tape with closely spaced emitters is included since it is a common practice among the three growers profiled, and is considered a key contributor to their success. Information from Cal Poly San Luis Obispo's "Drip and Micro Irrigation Design and Management" manual published in 2007 by the Irrigation Training and Research Center (ITRC) is excerpted, along with field studies conducted by Clearwater Supply in Ontario, Oregon.

Case Study 1: Reiter Berry Farms, Watsonville, CA

Frank Estrada, area manager for Reiter Berry Farms in Watsonville, California manages over 300 acres of strawberries for Driscoll and sets strawberry transplants with drip irrigation. "We stopped using sprinklers over three years ago for anything except pre-irrigation prior to bed prep," says Reiter. He reports that soil prep, tape placement and irrigation scheduling are the keys to success, and that beds must be square and consistent with 27-29 inch wide tops. For strawberries on 52 inch centers, two rows of premium drip tape with closely spaced outlets and a high flow rate are placed in the center of a dry bed, 10 inches apart, and buried 0.5 – 1.0 inch deep. The beds are then irrigated about 3-4 hours and marked. Then, transplants are placed 5 inches from each tape line on the bed shoulder and packed in by laborers, and then machine rolled. The block is then immediately irrigated until water from the drip lines begins to bleed

from the beds. In a clay loam, this occurs after about 8 hours of irrigation. In a sandy loam, this occurs sooner, and may require more frequent irrigation for shorter duration.

"There is no difference in quality or production in my 'drip only' fields versus sprinkler fields," says Estrada. "We save in sprinkler equipment and labor costs, and use less water and energy during the first two weeks of production. Since drip runs at lower pressures and wastes less water than sprinklers, using drip for the rest of the season saves water and energy over sprinklers as well." Another reason Estrada prefers drip to sprinklers is the reduced incidence of weeds in his organic fields. "With drip, I'm not applying water in-between the beds, so weed growth is greatly reduced. With sprinklers, weeds germinate everywhere and I am forced to hand weed, which is expensive."

Bed Width is 27-29 inches wide.

Tape is placed 10 inches apart, about 0.5 – 1.0 inches deep.

Strawberry transplants will be placed 5 inches from each of the tape lines.

Case Study 2: Naumann Ranch, Oxnard, CA

Mike Naumann of Naumann Ranch in Oxnard, California manages 800 acres of mixed vegetables along with his brother Brian. "We haven't used flood or sprinklers for years," says Naumann. This was accomplished by developing a simple valve and layflat system that allows immediate irrigation of new celery transplants.

"After each pass of the transplant machine, we open up additional drip lines with closely spaced emitters from the layflat by changing positions of an improvised marine valve – this way, newly transplanted rows receive water *immediately* after planting," says Naumann. "This is in contrast to waiting for an entire block to be completed, and the result is reduced mortality and stronger plant growth. Not only have we increased yields and uniformity, but we have eliminated the expense of bringing in traditional sprinklers to set transplants, and the unwanted side effect of runoff." Rollers help to properly secure the transplants in the soil such that the entire bed is quickly 'blackened' with moisture soon after the drip lines are pressurized. "If we were using sprinklers, the plants would have to wait until the block is completely planted, and would likely stress before receiving water. The logistics of above ground pipelines would be difficult to work around as well, and windy conditions often ruin sprinkler uniformity and drift water into unwanted fields or roadways. We have cut water use in half compared to other irrigation methods used in the past, and have also saved on irrigation labor which reduces our costs." In the same geographic region, artichoke transplants are set with drip tape as well.

Food safety is one of the more difficult challenges vegetable growers face. "Given the current pressures regarding food safety, we don't feel we could even farm if it weren't for drip," continues

Naumann. The Naumanns believe their drip irrigation and harvest practices help safeguard them from the potential disasters that other growers have experienced in recent months and years. “E. Coli grows where there is water. In drip irrigated fields, less area is irrigated, and it is likely that less water runs off or is left standing,” says Michael Cahn, University of California Farm Adviser in Monterey County, CA. Thus, avoiding sprinkler usage may contribute to food safety as well.

Rollers help secure the transplants in the bed.

A valve opens up additional drip lines after each pass of the transplant machine.

The bed is quickly blackened with moisture supplied by the drip tape immediately after transplanting.

Case Study 3: Standage Farms, Inc., Vale, OR

Larry Standage of Standage Farms, Inc. in Vale, Oregon germinates onion seeds with his drip irrigation system. The drip tape is installed after the onion seeds are planted, the tape supplying the moisture for germination. Drip tape outlets are spaced 12” apart, and the tape flow rate of .22 gpm/100’ translates into an application rate of .06 inches per hour. Standage feels that the best wetting pattern is achieved with a 12 hour set, with intervals between irrigations determined by weather and sensors.

“Drip nurtures a healthier, stronger plant, which really shows up during extreme heat events,” explains Standage. “Drip also creates an advantage for cultural activities during the growing season since the furrows are always dry as opposed to flood, which always leaves wet spots. The root system is more robust which prevents stress, and uniformity of water application translates into uniformity of crop. This is a huge advantage for our customers, and even in our own packing sheds, because variable size, shape and color creates problems in both packing and marketing. The contents of each 50 pound bag of onions is superior because the crop is more uniform in size, shape and color, thus the customer is more pleased. I use drip to keep my customers coming back.”

Other growers are successfully germinating lettuce seed using similar bed shaping, tape placement and irrigation scheduling techniques. After germination, the lettuce seedlings are thinned to a final spacing by hand with a hoe. The benefits include keeping the furrows dry to avoid weed germination, and reducing disease pressures. These two benefits are especially important in organic production where treatment is very expensive without chemicals. Improved bed softness is also cited as a benefit of drip vs. sprinklers.

Germinating onion seed with drip irrigation helps ensure uniform production in size, shape and color.

Lettuce seeds are germinated with drip, and seedlings are then thinned with a hoe.

The Advantages of Closely Spaced Drip Tape Emitters

The use of closely spaced drip tape emitters to achieve desired wetting patterns is a technique common to the three case studies cited above, and contributes to the ability to successfully germinate seeds and set transplants without sprinklers. In addition to actual grower experiences, this technique is supported by a university training manual, and by a dealer’s field trial.

Comments from Cal Poly ITRC’s drip manual

The comprehensive “Drip and Micro Irrigation Design and Management” Manual published in 2007 by the Irrigation Training and Research Center (ITRC) at Cal Poly San Luis Obispo reports that the right wetting pattern can increase crop quality and that closely spaced emitters can reduce both purchase and operational costs vs. wider spaced emitters. “For the Central Coast

of California, most growers use an emitter spacing of 8 inches to 16 inches, with a shallow burial depth. Even with these close spacings it may be important to match the spacing to the soil type. Closer hole spacings can result in a more continuous soil wetting pattern. The most common hole spacing in California is 12 inches. (With) eighteen inch spacing in SDI applications one must do all of the following: a) Raise the pressure to 20 psi during germination to provide a higher flow rate that subs better, b) Apply water to the soil surface until it is very wet (in fact, water will actually be standing in the furrows), and c) Use heavy wall drip tape (about 15 mil) in order to handle the high pressure without tape damage." (pg. 288.)

The report also states that buying heavier mil tape, increasing pressures and wetting the soil surface are all undesirable side effects of using widely spaced emitters in an SDI application. In addition, initial buying costs and post-purchase operation costs will be higher, and soil surface wetting may damage crop quality and/or encourage unwanted weed growth. Thus, for optimal performance, closely spaced emitters are often the best choice to achieve desired wetting patterns.

Field Trial by Clearwater Supply

A field trial conducted by Jim Klauzer of Clearwater Supply in Othello, Oregon provides visual evidence of the advantages of closely spaced emitters to achieve desirable wetting patterns. The photo below on the left shows a 12 inch emitter spacing on the left of middle row, and an 8 inch spacing on the right of middle row. Both tapes emit the same amount of water: .22 gpm/100'. The soil is an Elijah – Sebree silt loam, one of the more difficult soils in the Treasure Valley. Clearly, the 8 inch spacing is creating a wetting corridor more quickly than the 12 inch spacing, a big plus for growers who seek to germinate seed and set transplants with drip. The photo on the right shows the 8 inch spacing after 30 hours of irrigation, where nearly the entire planting bed has been moistened. This type of wetting pattern is essential to germinate seed or set transplants without the use of sprinklers.

Drip tape with 12 inch spacing on left, 8 inch spacing on right (both emit .22 gpm/100'). Photo courtesy of Jim Klauzer, Clearwater Supply.

Drip tape with 8 inch spacing, 22 gpm/100', after 30 hours of irrigation. Photo courtesy of Jim Klauzer, Clearwater Supply.

Conclusion

In conclusion, fruit and vegetable row crop producers are successfully germinating seed and setting transplants with their drip irrigation systems instead of using sprinkler systems for this specific task. This has been accomplished by paying careful attention to soil preparation, drip tape placement and irrigation scheduling, and by developing techniques to immediately apply moisture to rows of transplants immediately after the transplant machine completes each pass. In addition, the use of closely spaced emitters helps to achieve the desired wetting pattern, which is essential to germination and transplant setting success. The use of closely spaced emitters for superior wetting patterns has been observed not only in the three case studies cited in this paper, but is also documented in a prominent university drip irrigation publication, and observed in private field trials conducted by an Oregon irrigation dealer.

The obvious benefits to eliminating the use of sprinklers for germination and transplants are numerous. First, the costs associated with the use of sprinklers is obviously reduced. Second, runoff and water use is reduced, and existing resource use is improved. Third, weed germination is reduced since drip targets irrigation water to the planting bed while sprinklers wet the entire field, including furrows, field edges and roads. Fourth, the incidence of disease is reduced since the plant canopy remains dry and the air less humid. Fifth, field accessibility is improved since sprinkler pipe does not impede other cultural operations. Sixth, the planting bed remains soft and is not hardened or crusted over from the use of sprinklers. Seventh, food safety may be enhanced since less standing water is available to harbor E.Coli. And eighth, farm safety conditions may be improved since heavy sprinkler pipe is no longer moved by laborers through uneven terrain that is often steep and/or muddy.

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References

Burt, Charles M. and Stuart W. Styles, 2007. Drip and Micro Irrigation Design and Management for Trees, Vines, and Field Crops, 3rd Edition, Irrigation and Training Resource Center (ITRC), California Polytechnic State University, San Luis Obispo, CA www.itrc.org

Toro Micro-Irrigation, 2009. Advantages of Closely Spaced Emitters. El Cajon, CA. Available at www.toromicroirrigation.com and www.dripirrigation.org.

Toro Micro-Irrigation, 2009. Drip Irrigation Helps Vegetable Growers Overcome Challenges. El Cajon, CA. Available at www.toromicroirrigation.com and www.dripirrigation.org.

Toro Micro-Irrigation, 2009. Quality Tape Yields Quality Onions. El Cajon, CA. Available at www.toromicroirrigation.com and www.dripirrigation.org.

Toro Micro-Irrigation, 2009. Row Crop Growers Using Drip Tape for More Than Irrigation. El Cajon, CA. Available at www.toromicroirrigation.com and www.dripirrigation.org.