Microirrigation for Sustainable Water Use

W-2128 (2009-2014)

Irrigation Strains Western Water Supplies

The West is home to some of the fastest growing communities in the nation, and these growing communities are putting additional strain on already overdrawn water supplies in the region. A major user of Western water is irrigated farmland needed to feed a growing world population. Adequate irrigation is necessary for good crop yields and quality, particularly in semi-arid and arid regions, but excessive irrigation can damage crops, and excess water can carry pollutants like chemicals and sediment into surface and groundwater.

Conventional irrigation systems that apply high volumes of water over wide areas can lose a lot of water through runoff, wind, or evaporation, and they often over or under-water plants. A more efficient option—microirrigation—delivers small quantities of water as needed above or below the soil surface to plants through emitters spaced along a water line. Microirrigation (MI) systems could help farmers reduce their draws on water supplies, but perceptions of high cost, poor reliability, tedious maintenance, and lack of support or guidance have made farmers hesitant to adopt the technology. Without information or recommendations for their particular farm conditions and crops, farmers have also struggled with irrigation scheduling, or determining when and how much water to apply, which is crucial for maximum water savings.

In microirrigation systems, water evaporation is kept to a minimum because water is delivered to the soil near the plant's roots, not sprayed into the air or over large, exposed areas. Water is supplied from a main line to separate smaller tubes that run along each row of plants. These tubes emit water at a very slow rate near the base of each plant. Computers and timers allow farmers to fine-tune the watering. Top photo by Ryo Chijiiwa, Flickr. Bottom photo by Mick O'Neill/NMSU.

Multistate Research Project Makes Microirrigation More Sustainable, Saves Water & Money

In 1972, researchers formed Multistate Research Project W-2128 to coordinate MI research across the U.S. Over the last five years, the group has made remarkable improvements to MI systems that have had huge environmental, economic, and societal impacts.

Improved Design

Recent research has influenced MI system design and manufacturing, leading to equipment that is easier to install, more durable, and more precise. These improvements have reduced the frequency and severity of MI system failures, cutting maintenance costs and ensuring reliable irrigation for crops.

Educated Farmers, Increased MI Use

Engaging with growers, W-2128 members have made certain that new MI technologies are appropriate for varying crops, soils, climates, and farmer needs and skills. Such extensive and robust outreach efforts have countered the perception that MI is difficult. In turn, more farmers—even farmers of lower-value crops—have increased adoption and successful use of MI.

Saving Water Saves Money

Farmers who have adopted the tools and methods tested and recommended by W-2128 have saved water and money. Cost savings have come largely from using improved MI systems to deliver just the right amount of water at just the right time. For example, Idaho farmers have saved 10% or more on labor and water pumping costs by following recommendations to measure soil water levels daily at multiple depths to know when soils are dry. W-2128 technology and tips were also critical in mitigating Texas' record-breaking drought in 2011. Farmers have seen additional cost savings by using these tools and methods to delay the start of irrigation, saving water for later in the season.

Research & Extension Highlights

For the last five years, agricultural engineers, plant and soil scientists, and economists participating in W-2128 have conducted a wide variety of studies and outreach efforts. Here are a few highlights that led to impressive impacts.

University of Idaho: demonstrated better crop yields with microirrigation than center pivot irrigation (32 tons per acre versus 28 tons per acre).

New Mexico State University (NMSU): tested and compared several models of drip tubing and emitters that can be used for inexpensive, low pressure microirrigation suitable for small farms.

University of California, Davis: designed a new tensiometer to monitor soil water potential below the root zone in real-time, 24/7.

USDA-ARS: designed infrared thermometers, which can be used to measure plant canopy temperature in real-time and developed irrigation scheduling strategies based on these temperatures.

Iowa State University: showed that using fewer sensors can still provide cost effective, detailed maps of soil moisture content if the sensors are placed strategically.

University of California, Davis: developed new wireless data logging systems for perennial crops. Growers do not have to remove or disconnect sensors, wires, or data loggers during yearly harvests.

Oregon State University: calibrated soil water sensors to improve the precision of irrigation scheduling.

More Water for More Farmers

By conserving water, newly adopted tools and practices have made it possible to irrigate additional land—particularly land not suitable for other irrigation technology. For example, MI systems could help farmers in Puerto Rico grow taro in dry conditions. This ability would allow farmers to establish taro on a commercial scale and replace imports and boost the economy. W-2128 research and extension efforts have also helped under-served clientele—like small-acreage farmers and low-input producers—take advantage of MI.

Improved Crop Yields & Quality

Farmers have seen improved crop yield and quality. In the U.S. Virgin Islands, drip irrigation has been very beneficial for the farming community and has produced marketable vegetables in a variety of trials, including lettuce, kale, and watermelon varieties. Furthermore, improved sensors help farmer detect irrigation problems early and correct them quickly, cutting costs due to crop losses.

Reduced Pollution & Health Risks

Adoption of MI technologies promoted by W-2128 has reduced risk of negative environmental and water quality effects. Applying agrochemicals precisely with MI has reduced the amount of agrochemicals that leach into groundwater or runoff into streams and lakes, limiting human exposure. For example, better use of irrigation systems and irrigation criteria in Oregon has increased onion yields and decreased groundwater nitrate contamination.

Using Non-Potable Water Conserves Freshwater

Research and extension have promoted the use of non-potable water resources in MI systems, saving freshwater for higher-value domestic and industrial uses. For example, W-2128 has adapted MI technologies to use recycled waters from confined animal feeding operations.

Restored Land

Researchers have also shown that MI is a viable strategy for establishing and maintaining trees, shrubs, and grasses on disturbed lands sites, including uranium mill sites on the Navajo Nation and former petroleum refineries. Replanting these sites reduces erosion and airborne dust, limiting threats to environmental and human health.

NMSU: determined how much to adjust irrigation timing and amount based on climate and plant canopy factors.

NMSU: determined irrigation scheduling for drought-tolerant landscape plants and vegetable crops.

Cornell University: measured evapotranspiration rates for apples and grapes in cool, humid climates and used this data to create an automated online system that New York growers can use to optimize irrigation.

Texas AgriLife Research: developed engineering guidelines for permanently installed MI systems that function well in the cracking, heavy clay loam soil of the Texas High Plains.

NMSU: developed a model of how soil temperature and moisture affect the life cycle of *Phytophthora capsici* and how the disease develops on chile and bell peppers.

NMSU: showed that shifting from furrow irrigation to drip irrigation can lower water inputs and the amount of nitrogen compounds that leach into the environment.

NMSU: tested and recommended the 2D model for scheduling MI for shallow-rooted crops to decrease pollution of groundwater.

W-2128 joint effort: developed guidelines for MI systems that irrigate with low quality water, including recommendations for using waters from human sources.

Colorado State University: high salinity groundwater can be used in MI systems to grow muskmelons without excessive harm to the crop or soil.

NMSU: initiated a phytoremediation project using MI to establish tree and shrub species at the former site of a petroleum refinery. Studies also showed that gravity-fed drip irrigation can be a viable strategy for establishing plantings in remote areas such as the sites of former uranium mills on the Navajo Nation.

University of Arizona: promoted using smartphone technology to help farmers, extension specialists, and scientists communicate, share data, and make good MI decisions in real time without traveling long distances.

Kansas State University: identified key barriers to increasing MI adoption, including rodent damage and perceived performance uncertainties.

W-2128 joint effort: shared research findings and recommendations with a variety of audiences via outreach and extension activities. W-2128 members held 145 outreach events with growers each year since 2009. In addition, they coordinated and presented technical sessions on MI scheduling at the 2009, 2012, and 2013 technical conference of the Irrigation Association. They also created websites to share guidelines and software and published numerous books and articles.

Want to know more?

Helpful websites:
http://www.cropinfo.net/MI/
http://micromaintain.ucanr.edu
http://www.crec.ifas.ufl.edu/extension/irrigation/

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Institutions from the following states contributed data on specific crops: AL (cotton, corn soybean, wheat), CA (almond, pecan, grape), FL (citrus, blueberry, strawberry), GA (cotton, corn, peanut), HI (sweet corn, vegetables), ID (turf, alfalfa, sugar beets), KS (corn, grain sorghum, sunflower, alfalfa, soybean), NM (pecan, poplar, tomato, onion, pepper, squash), NY (apple, grape), OR (onion, poplar, potato), Puerto Rico (citrus, avocado), TX (corn, cotton, sorghum, soybean).

This Impact Summary was compiled and designed by Sara Delheimer.

NMSU researchers determined that hybrid poplar trees are well-adapted to MI in the Four Corners region. These trees are being planted to remediate an abandoned oil refinery site. Photo by Mick O'Neill/NMSU.