Drip Irrigation Technology: A Resource Management Tool for Farmers

By John C. Roberts, in collaboration with Stuart W. Neel

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ater and arable land were once considered globally abundant and renewable resources. As we enter the 21st century, however, water is becoming recognized as one of the world's increasingly valuable and scarce natural resources. The agricultural community worldwide is recognizing the need to adapt sustainable farming practices to conserve water and avoid damaging productive farmland.

Competing demands for water are already leading to conflict where regional supplies are limited. As the strain on the world's water resources continues to intensify, difficult decisions about water use and allocation will be made. Farmers, industrialists and the general population will be forced to implement conservation programs.

Drip irrigation technology addresses the urgent need to conserve water and nutrients to a plant's root zone in the precise amounts required to meet the plant's needs. This means that less water, less fertilizer and less pesticides will potentially be used while at the same time increasing yields and producing higher quality crops.

**Introduction to Drip**

Although drip irrigation was pioneered in England in the 1940s, it was not until the advent of polyethylene plastics in the 1960s that drip irrigation was developed as a commercially viable technology in the United States and abroad. Initially, many farmers did not consider drip irrigation practical because it was such a significant departure from traditional flooded and sprinkler methods. However, years of cooperative research among farmers, universities and government agencies have demonstrated the many advantages of drip irrigation. Today, as a result of the proven agronomic, conservation and economic benefits, drip irrigation has gained global acceptance and is being implemented at a rapid pace by competitive growers worldwide on vegetables, fruits, flowers, cotton, sugar cane, vineyards and many other crops.

**Drain vs. Traditional Methods**

Traditional irrigation methods such as flood and sprinkler apply water at high rates to a large area with limited ability to distribute the water to exactly where it is needed and promote consistent growth. This is accomplished through high frequency irrigation cycles, and by applying water to the furrows in an undefined way. Irrigation systems are often designed to provide water at the highest rate possible, to ensure that the water is delivered before the plants deplete the soil moisture.

**Benefits of Drip Irrigation**

Water conservation was originally thought to be the primary benefit of drip irrigation. Experience has shown that a well-designed, need-fed and managed drip irrigation system provides other equally important agronomic and economic benefits. As a result, farmers worldwide are installing drip technology:

- **Improved Crop Quality and Increased Yields** - Using traditional irrigation methods, water and fertilizer cannot practically be applied in small amounts on a frequent basis. This means that the crop alternates between having too much and too little water and nutrients available. Drip irrigation scheduling allows water and nutrients to be delivered exactly when and where the crop needs them resulting in larger, higher quality harvests.
- **Water Conservation** - Drip systems allow a farmer to apply only the precise amount of water a plant can beneficially use. Additionally, drip systems do not wet the entire field surface. As a result, water loss to evaporation, deep percolation and run-off are minimized. This not only conserves water, but also minimizes ground-water contamination.
- **More Flexible Field Operations** - Cultivation, spraying and harvesting can continue even when irrigating.
- **Lower Input Costs** - Drip tape enables the uniform delivery of water, chemicals and fertilizers on an as needed basis. This minimizes the over application of costly resources, thereby reducing input costs.
- **Energy Conservation** - The low operating pressure (.5 bar) required for drip systems reduces pumping requirements, thereby conserving less energy than sprinkler systems.
- **Reduced Disease** - Less disease can occur because foliage is not wetted and soil moisture is controlled.
- **Less Weed Growth** - Only the crop is irrigated, minimizing the weed growth between plant rows.
- **Problem Soils Can Be Formed More Effectively** - Drip systems are ideal for heavy soils with low infiltration rates, since the water can be applied at a slow enough rate for the soil to absorb it, minimizing or eliminating surface run-off.
- **Sandy soils, which are incapable of storing large amounts of water, also can be farmed with drip systems using very high frequency irrigation.**

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Competing demands for water are already leading to conflict where regional supplies are limited. As the strain on the world's water resources continues to intensify, difficult decisions about water use and allocation will be made. Farmers, industrialists and the general population will be forced to implement conservation programs.

Drip irrigation technology addresses the urgent need to conserve water and preserve the environment by enabling a farmer to uniformly deliver water and nutrients to a plant's roots at the precise amounts required to meet the plant's needs. This means that less water, chemicals and fertilizers will potentially be used while at the same time increasing yields and producing higher quality crops.

**INTRODUCTION TO Drip**

Although drip irrigation was pioneered in England in the 1940s, it was not until the advent of polyethylene plastics in the 1960s that drip irrigation was developed as a commercially viable technology in the United States and Israel. Initially, many farmers did not consider drip irrigation practical because it was such a significant departure from traditional furrow and sprinkler methods. However, years of cooperative research among farmers, universities and government agencies have demonstrated the many advantages of drip irrigation. Today, as a result of the proven agronomic, conservation and economic benefits, drip irrigation has gained global acceptance and is being implemented at a rapid pace by competitive growers worldwide on vegetables, fruits, flowers, cotton, sugar cane, vineyards and many other crops.

**Drip vs. Traditional Methods**

Traditional irrigation methods such as fixed and sprinkler apply water at high rates to a large area with limited ability to distribute the water to exactly where it is needed and promote consistent growth. This is accomplished through high usage of frequent irrigation cycles, and by applying water to the soil surface rather than to the drip irrigation system as often as required by the crop.

Figure 1 illustrates the soil wetting pattern which can be maintained with a drip system. Drip irrigation systems can be placed on the soil surface as shown in the diagram, above, or they can be buried at depth, ranging from 4 to 30 centimeters.

Burdied drip systems are less susceptible to mechanical and pest damage.

**Drip Irrigation Technology**

The most important drip irrigation systems for the future are drip tape and in-line emitters. The primary factors which determine the most appropriate product type are application, cost, field conditions and management practices.

Drip tape is a thin wall hose with emitters molded into the wall of the tube. The emitters are available in wall thickness ranging from 0.12 mm to 0.40 mm and emitter spacing from 10 cm to 60 cm. A variety of flow rates are available to meet the needs of specific crops and growing conditions.

Drip tape is generally the most cost-effective technology and is widely used in single-sensor and long-term row crops. In-line emitter systems have an injet molded emitter placed on the inside of the hose during the extrusion process. This type of hose is available in wall thickness ranging from 0.20 mm to 1.25 mm and emitter spacing from 40 cm to 120 cm. In-line emitters are most commonly used in long-term vineyard and orchard applications.

**PARTS & LAYOUT of A Drip Tape System**

A drip irrigation system can be designed for any size farm, but all systems will have similar major system components: pump filters, pressure regulators, valves and drip tape. An optional, but highly recommended system component is a chemical and fertilizer injection subsystem. Automatic valve controllers, flow meters, soil moisture sensors, and other accessories are often installed on sophisticated systems.

**Benefits of Drip Irrigation**

Water conservation was originally thought to be the primary benefit of drip irrigation. Experience has shown that a well-designed, needed and managed drip irrigation system offers other equally important agronomic and economic benefits. As a result, farmers worldwide are installing drip technology.

- **Improved Crop Quality and Increased Yields**—Using traditional irrigation methods, water and fertilizer cannot practically be applied in small amounts on a frequent basis. This means that the crop alternates between having too much and too little water and nutrients available. Drip irrigation scheduling allows water and nutrients to be delivered exactly when and where the crop needs them resulting in larger, higher quality harvests.
- **Water Conservation**—Drip systems allow a farmer to apply only the precise amount of water a crop can beneficially use. Additionally, drip systems do not wet the entire field surface. As a result, water loss to evaporation, deep percolation and run-off is minimized. This not only conserves water, but also minimizes ground-water contamination.
- **More Flexible Field Operations**—Cultivation, spraying and harvesting can continue even when irrigating.
- **Lower Input Costs**—Drip tape enables the uniform delivery of water, chemicals and fertilizers on an as needed basis. This minimizes the overall application of costly resources, thereby reducing input costs. Cost savings on chemicals of 25 to 50% are not uncommon with drip systems.
- **Energy Conservation**—The low operating pressure (0.5 bar) required for drip systems reduces pumping requirements, thereby consuming less energy than sprinkler systems.
- **Reduced Disease**—Less disease can occur because foliage is not wetted and soil moisture is controlled.
- **Less Weed Growth**—Only the crops is irrigated, minimizing the weed growth between plant rows.
- **Problem Soils Can Be Farmed More Effectively**—Drip systems are ideal for heavy soils with low infiltration rates. Since the water can be applied at a slow enough rate for the soil to absorb it, minimizing or eliminating surface run-off. Sandy soils, which are incapable of storing large amounts of water, also can be farmed with drip systems using very high frequency irrigation.

**Figure 1: Wetting pattern of an above ground drip installation.**
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Delmhorst Oypsum Blocks, installed as soil moisture sensors, provide accurate soil moisture measurements that read manually with the new Digital Modes KSO-1 Soil Moisture Transmitter.
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Concenes of Drip Irrigation

Along with its many benefits, drip irrigation systems also have some potential cost and operational disadvantages. Most of these can be overcome through good system design, proper installation, and ongoing maintenance and management.

The initial cost of a drip irrigation system per hectare is typically higher than other irrigation systems. Filters, pumps, regulators, valves, gauges, and manifolds must be purchased as start-up items for the system. These costs, though substantial, are one-time costs. Drip tape is the only significant recurring cost, but it represents only approximately 20% of the initial system cost.

Drip systems require more intensive management than flood or sprinkler systems. In order to realize the many benefits discussed above, the farmer must constantly be monitoring the growing environment and scheduling irrigation to meet the plant's needs. Frequent inspections of drip systems are recommended and the timely correction of problems is critical to not risking a crop.

Farming with drip irrigation typically requires a change in cultivation, planting, and harvesting practices. Educating personnel on these changes is required during the first season drip is used, but these practices quickly become a standard part of the farming operation.

The small opening in drip emitters may be plugged by dirty water. Therefore, water quality should always be analyzed to identify possible problems, and a well-designed drainage system must be installed.

Some crops do not germinate well with drip irrigation. In these cases, portable sprayers are often used for germination. Once started, the crop can be irrigated with a drip system to optimize plant growth.

A drip tape system will not make a farming operation good. On the contrary, you start with a good farming operation and then adapt drip tape irrigation and adjust farming practices around the new method to ensure success.

The Choice

Drip irrigation is a proven and rapidly growing technology. It is compatible with global water conservation and environmental protection goals. Drip systems can yield substantial economic benefits if properly designed, installed and maintained. Today, less than two percent of the world's irrigated

Drip tape irrigation on crops such as peppers, has proven successful and cost effective, increasing yields and revenue. Photo courtesy Roberts Irrigation Products, Inc.

Nashville Expo Exhibit Hall Will Be Filled to Capacity

All booth space for the 1997 International Irrigation Exposition in Nashville, Tennessee, is November is reserved and hotels are filling up quickly, reports IA Expo manager Denise Stone. "Registration packets are in the mail and we encourage everyone to send them back as soon as possible." Stone adds, "Packets include registration forms for educational seminars.

The Opryland Hotel and Convention Center is nearly filled up quickly. That includes hotels rooms, the Showset, the Showset Exposition, and Golf Tournament. "Sufficient in-site hotel space is available so anyone who wishes to attend can attend."

The IA Educational Offers Three New Courses

The Irrigation Association has expanded its list of sanctioned educational courses to help landscape and irrigation contractors train their crews. The new half-day courses are:

- Sprinkler System Scheduling
- Field Hydraulics
- Design Hydraulics

IA staff will help local sponsors arrange registration and provide materials for those other courses.

Some of the other courses offered by the IA:
- Irrigation System Installation and Maintenance
- Electrical Troubleshooting
- Landscape Irrigation Design
- Landscape Irrigation Auditing
- Comprehensive Irrigation Contracting

Call Lori at Morgan at the IA for a list of currently scheduled courses around the country. Companies interested in sponsoring an IA educational event may call Morgan at IA director of education Tim Wilborn.

All training materials are available through the IA, and can be ordered through the association's Web site at http://www.irrigation.org.

IA Board Eyes Charlotte for Future Expo Site

The Summer Board Meeting was held in Charlotte, North Carolina, last month so officers and board members could evaluate Charlotte as the site for a future International Irrigation Exposition and Technical Conference. Three days of intensive meetings each summer help the association set and achieve its goals.

IA President Louis Toth set the agenda for this meeting, "North Carolina has become a major distribution point for West Coast Irrigation manufacturers who want to serve the East Coast," Toth remarked. "Irrigation is growing both nationally and internationally. The IA is growing with it."

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