

Mobile Drip Irrigation (MDI): Benefits and Challenges for Its Adoption and Use¹

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Introduction

Overhead sprinkler irrigation is one of the most widely used methods in agriculture. It is designed to mimic natural rainfall by distributing water through a pressurized system of pipes and spray nozzles. This approach is effective for covering large areas and is relatively easy to install and operate, making it popular among farmers worldwide. However, sprinkler systems can lead to significant water loss through evaporation and wind drift, especially in hot or windy climates. To address these challenges, mobile drip irrigation (MDI) has emerged as an innovative alternative.

Mobile drip irrigation is an integrated irrigation system that combines the high water-use efficiency of traditional surface drip irrigation with the flexibility and adaptability of center pivot or linear mobile irrigation. MDI reduces water loss through evaporation, wind drift, and runoff by delivering water directly to the soil surface via driplines dragged behind the pivot (Figure 1).

An MDI system is an excellent strategy for water-limited regions because it conserves irrigation water (Kisekka et al. 2017; O'Shaughnessy and Colaizzi 2017) and may reduce fertilizer leaching, particularly in sandy soils prone to nutrient loss. This is particularly critical for agricultural systems in Florida, where freshwater use has risen sharply and reduced water reserves. Concurrently, nitrate-nitrogen (NO₃-N) leaching and runoff from agriculture pose risks to groundwater and surface water quality.

In Florida, best management practices (BMPs) have been implemented to mitigate these impacts (Acharya and Sharma 2025; Acharya et al. 2025; Morrow et al. 2025). However, rising fertilizer and fuel costs for irrigation and application highlight the need to assess irrigation technologies for economic and environmental sustainability. This requires evaluating irrigation systems under similar soil and climatic conditions and conducting

regional analyses to determine crop response, economic feasibility, and environmental impacts across different irrigation systems.

This Extension publication presents a comprehensive overview of the mobile drip irrigation (MDI) system, covering its historical development, system design, and key installation considerations. It explains how water is distributed within an MDI system and evaluates the economic factors involved in converting a center pivot irrigation system to MDI. The publication outlines both the advantages and limitations of adopting MDI technology. A practical decision checklist is included to help determine whether an MDI system is suitable for a specific field operation. The publication serves as a valuable resource for students, researchers, Extension agents, growers, agricultural consultants, irrigation managers, and state agency personnel.



Figure 1. A center pivot irrigation system equipped with mobile drip irrigation technology at Live Oak, FL.

Credit: Bhimsen Shrestha and Vivek Sharma, UF/IFAS.

Current Mobile Irrigation Systems and History of MDI

Overhead irrigation using center pivot or lateral move sprinkler irrigation systems is the most common method used for irrigating field crops in the United States. Early center pivot irrigation systems relied on high-pressure impact sprinklers mounted on top of the lateral pipe. These systems were often characterized by low application efficiency (approximately 60%), excessive wind drift and evaporation loss during water application, potential runoff, and high energy requirements (Peters 2016).

Over time, numerous modifications have been introduced on center pivot irrigation to improve efficiency and minimize water losses (Figure 2). One such advancement is the mid-elevation spray application (MESA) systems in which sprinkler nozzles are installed on a drop-down hose (i.e., “drops”) using the gooseneck assembly and are located midway between the pivot lateral pipe and soil surface. Most of the new center pivot irrigation systems are equipped with MESA sprinkler assemblies. Although MESA systems are efficient, they are still associated with wind drift and evaporation losses (Figure 2).

To further reduce the water application losses, low-elevation spray application (LESA) and low-energy precision application (LEPA) were introduced (Lyle and Bordovsky 1983; Collaizzi et al. 2004). LESA systems apply water within the canopy using sprinkler nozzles placed 12–18 inches above the soil surface, whereas the LEPA system applies water directly to the soil surface using the drop-socks or bubbler nozzles. These systems

generally operate at a low pressure (around 15 psi) and have higher application efficiency (90%–97%) (Figure 2). However, both methods require a high number of sprinklers, and the drops cannot be easily integrated into existing center or lateral pivot systems. Although both LEPA and LESA irrigation mitigate wind drifts, evaporative and runoff losses can still be an issue if not managed properly. To further minimize the evaporative losses, MDI was introduced, which combines the benefits of both center pivot and drip irrigation systems.

MDI has been in use for more than 20 years and has been researched for more than 45 years. The MDI was first introduced and tested by Rawlins et al. (1974) as “Traveling Trickle System” in California. Phene et al. (1981; 1985) worked on the design and components of a traveling trickle irrigation system (TTIS) for row crops, and evaluated water application uniformity, advantages, and disadvantages of TTIS.

Although there is limited research on MDI performance, MDI has been tested by various research institutions in the U.S., including Kansas State University, Texas A&M University, and Washington State University (Kisekka et al. 2017; O’Shaughnessy et al. 2017; Molaei et al. 2021). Recent advancements in drip irrigation technology, including pressure compensating emitters and improved filtration systems, have attracted more interest in MDI among farmers and researchers (Molaei et al. 2022). Two irrigation technology companies that provide commercial MDI technologies include Dragon-Line LLC under the trade name of Dragon-Line MDI ([Dragon-Line](#), Ulysses, KS, USA), and Netafim under the trade name of Precision Mobile Drip Irrigation™ ([Netafim USA](#), Fresno, CA).

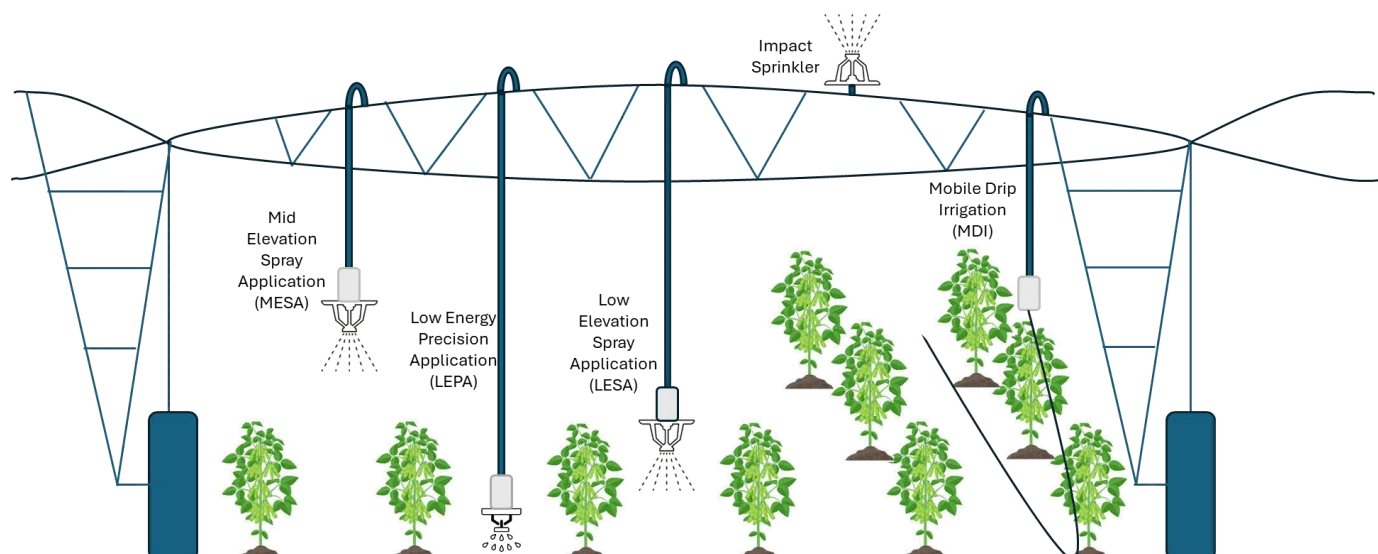


Figure 2. Mid-elevation spray application (MESA), low-energy precision application (LEPA), low-elevation spray application (LESA), high-pressure impact sprinklers (impact), and mobile drip irrigation (MDI) system.

Credit: Vivek Sharma, UF/IFAS.

Design, Installation, and Working of Mobile Drip Irrigation (MDI) System

In MDI, multiple high-performance drip tubes are placed at a close spacing of 20 to 60 inches, depending on the crop of interest, with in-line emitters spaced approximately every 6 inches. These tubes are attached to the drop hose and dragged behind the center pivot or linear move system, which moves over the crop field for precise water delivery (Figure 1).

To ensure uniform water application, the lengths of drip tapes are adjusted across the pivot. Drip tapes closer to the center of the pivot are short, while those farther away are longer, like how sprinkler nozzle sizes increase with distance from the pivot. The drip tape length ranges from approximately 5 ft to 100 ft long depending upon the size of the center pivot. In general, most systems are designed for dual purposes, where sprinkler nozzles are left in place. This allows flexibility in switching between the sprinkler and MDI systems. The major components of MDI include:

1. a center pivot or lateral move system with controller,
2. MDI manifold,
3. driplines with pressure compensating (PC) emitters,
4. a winch system, and
5. a filtration system (Figure 3).

An existing sprinkler move system can be converted to MDI using control valves. It is easy to install with little guidance from manufacturers, because most of the parts

are available as ready to install (Dragon-Line, Ulysses, KS, USA). Brief descriptions of the different components of the MDI system are listed below.

1. **MDI manifold:** The manifold works as a main line in surface drip irrigation, where it receives water from the drops of the center pivot and delivers water to the driplines (Figure 3B). Most MDI systems are designed for dual purposes, where sprinkler nozzles are left in place, which allows flexibility in switching between the sprinkler and MDI systems. A control valve along with a T-fitting is used to divert water into the MDI manifold, which allows water influx to both sprinkler nozzles and the MDI system (Figure 4).
2. **MDI drip tubes:** The MDI system uses polyethylene drip tubes (8–15 mil) with in-line emitters with a flow rate of 1 or 2 gph and emitter spacing of 6 or 12 inches. The drip tubes are spaced 20–60 inches apart based on crop and soil type. For example, sandy soil may require closer-spaced drip tubes to fulfill crop water demand. On the other hand, for heavy soils such as clay (with low infiltration rate), longer dripline spacing allows a greater amount of time for water to infiltrate into the soil.
3. **Winch system:** The pulley system is comprised of individual winches, one at each end of the pivot and others at middle positions between the ends based on the length of the spans. The hybrid winch system allows the movement of driplines both horizontally and vertically, such that it can be adjusted to varying

planting rows and crop heights, including peanut, alfalfa, small grains, corn, sorghum, etc. In addition, the winch system provides weight support, ensuring that the manifold with driplines will remain nearly level without significant sagging.

4. **Pressure compensating (PC) emitters and filtration system:** The PC emitters deliver the same amount of water even when the pressure changes and allow for uniform water distribution in varying field elevation. They include a silicone diaphragm that moves up and down as pressure fluctuates to control the flow

(Figure 3D). The PC emitters also have a self-flushing mechanism that protects emitters from clogging. Further filtration systems are recommended to protect emitters from clogging from dirt and debris. Different filtration systems, ranging from coarse mesh filters to media filters that use granite and silica to trap fine particles, are recommended with an MDI system. Figure 3F represents the installation of a 4-inch Mini Sigma Automatic Self-Cleaning Screen Filter at the center pivot main line.



(A) Center pivot



(B) MDI Manifold



(C) Drip tubes with in-line emitters



(D) A PC drip emitter



(E) Winch system at the end of the pivot



(F) Filtration System

Figure 3. Major components of a mobile drip irrigation (MDI) system. (A) Center pivot. (B) MDI manifold. (C) Drip tubes with in-line emitters. (D) PC drip emitter. (E) Winch system at the end of the pivot. (F) Filtration system.
Credit: Bhimsen Shrestha and Vivek Sharma, UF/IFAS.

Economics of MDI

The conversion cost of existing center pivots and linear moves to the MDI system ranges from \$200 to \$400 per acre. The anticipated cost for equipment and installation of MDI ranged from \$150 to \$200 per acre without including filtration, pressure regulation, and maintenance costs (Yost et al. 2019). The cost of converting LESA to MDI was estimated at \$245 to \$285 per acre (O'Shaughnessy and Colaizzi 2017).

Along with the initial investment costs associated with installation, MDI requires regular inspection and maintenance of the system. The maintenance costs may include costs related to periodic flushing out and replacement of driplines. The lifespan of MDI systems generally ranges from 10 to 15 years, although this can be affected by the environmental conditions in which they operate (Reynolds et al. 2020).

Advancements in MDI design and components could eliminate the labor cost gap between MDI and other

mobile sprinkler irrigation systems (Kisekka et al. 2017; Reynolds et al. 2020). MDI can reduce pivot tire maintenance costs because it avoids wheel rutting problems. Additionally, the costs of emitter clogging maintenance can be reduced with the use of a filtration system and self-flushing pressure compensating emitters.

The payback period for conversion to MDI for high-water-use crops such as corn ranges from 2.3 years to 7.6 years based on scale of investment at 3% discounting rate (Table 2). Agricultural producers growing crops with greater water requirements can more rapidly recover the expenses associated with adopting MDI technologies through improved water conservation measures compared to growers with moderate- to lower-water-consuming crops (Reynolds et al. 2020).

Table 2. MDI payback period (years) for different crops with a 3% discounting rate (adapted from Reynolds et al. 2020).

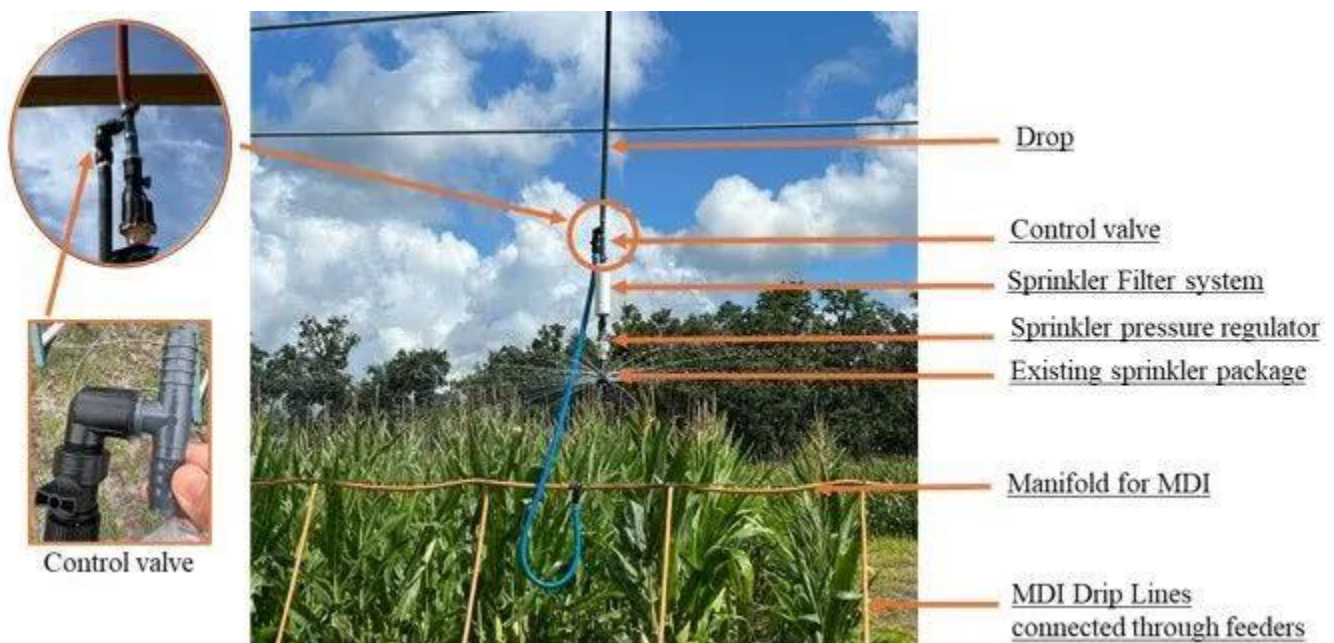


Figure 4. A hybrid MDI system with an existing sprinkler package.

Credit: Bhimsen Shrestha and Vivek Sharma, UF/IFAS.

Advantages and Disadvantages of MDI

Mobile drip irrigation systems offer clear advantages, such as higher water-use efficiency, reduced evaporation, and adaptability across crops compared to other irrigation systems. However, they also have disadvantages, such as higher setup costs, maintenance needs, and limited suitability in certain soils. Major advantages and

disadvantages of MDI systems are discussed below. Table 3 compares the characteristics, major advantages, and disadvantages of different irrigation systems.

Major Advantages of MDI

Water Saving

MDI applies water near the crop rows in a continuous band and does not wet the entire area (Figure 5), allowing deeper movement into the soil profile. Compared to

conventional sprinkler irrigation systems, the water saving potential of MDI ranges from 20% to 50% (Kisekka et al. 2017; O'Shaughnessy and Colaizzi 2017). However, the efficiency and performance of MDI technology could be less noticeable during the heavy precipitation season (Oker et al. 2018).

MDI systems provide better moisture distribution of water in the soil profile. In general, the application efficiency of MDI ranges from 90% to 95%, and the flow uniformity should be equivalent to that of standard drip irrigation. The MDI system also provides better lateral water redistribution in the soil profile, ensuring uniform water access for crops between rows (Kisekka et al. 2017).



Figure 5. Water application in a band near corn rows after irrigating with mobile drip irrigation.

Credit: Bhimsen Shrestha and Vivek Sharma, UF/IFAS.

Energy Saving

The MDI system can save energy by lowering power consumption, which is achieved through reduced pumping and increased application efficiency. The MDI systems can operate at pressures as low as 10 psi and perform well with low-capacity wells (Jenkins and Teeter 2020). Because the pressure requirement for MDI is lower than that of sprinkler packages, it can eliminate high pressure buildup in the center pivot. The MDI driplines have shown that they can reduce pressure loss in the system and improve energy efficiency during operation (Khairy et al. 2016).

Potential to Minimize Nitrate Leaching

Increased application efficiency of MDI results in less use of irrigation water, which could contribute to reducing irrigation-driven nitrate leaching into the groundwater and springs. There has been limited research focused on quantifying and comparing nitrate leaching in MDI versus other irrigation systems. More field-based studies on

varying environmental conditions are required to document the potential of MDI in minimizing soil nitrate leaching.

No Wheel Track Rutting

The MDI system eliminates the problem of wheel track rutting because it does not wet the wheel tracks (Figure 6).



Figure 6. No wheel track rutting under the MDI system.

Credit: Bhimsen Shrestha and Vivek Sharma, UF/IFAS.

Soil Health

MDI can reduce soil compaction and crust formation compared to sprinkler systems, promoting soil health. For example, when the sprinkler droplet hits the soil surface with sufficient energy, it breaks the soil aggregates into fine soil particles. These fine particles are carried by water and settle in the soil pores, resulting in a compacted, sealed surface that decreases soil infiltration. Because the MDI system does not wet the entire crop field, it promotes deep water infiltration into the crop root zone. Note that this benefit is more evident in fine-textured soils than in coarse-textured soils.

Yield Optimization and Weed and Disease Management

In the hot and humid conditions of the southeastern United States, various studies reported several disease

issues (e.g., southern blight; Sclerotinia blight; pod rot; early and late leaf spot), especially in peanut crops managed under overhead sprinkler irrigation systems due to wet canopy, that impacted the overall yield (Lanier et al. 2004). Because MDI does not wet the entire crop, it reduces favorable conditions for many fungal and bacterial diseases that thrive in moist environments. At the same time, dry soil between the plant rows suppresses weed growth and optimizes crop yields.

Flexibility

MDI provides flexibility for performing fertigation and chemigation into soil. Additionally, it is flexible to grow low-profile crops (alfalfa, peanuts, oats, etc.) to high-profile crops (corn, sorghum, etc.). Some researchers reported successful cultivation of cotton (Koudahe et al. 2024) and watermelon (Soto et al. 2024) under an MDI system. The performance of MDI has been evaluated on several types of soil, such as silt loam and clay loam. More research is needed to determine how well it works in sandy soils.

Major Disadvantages and Constraints of MDI

Requirement of Water Filtration System

A filtration system is required to reduce emitter clogging in driplines. A 177 micron/80 mesh filtration system is recommended, which adds to the cost.

Equipment, Installation, and Maintenance Costs

The equipment purchase, installation, and maintenance costs for MDI could be higher than sprinkler packages. Maintenance costs for MDI include periodic flushing out of driplines, replacement of driplines when they wear out, and periodic maintenance of the filtration and winch system.

However, MDI is less expensive than surface drip irrigation. In general, MDI systems are designed for low pressures (i.e., under 10 psi), with an option to self-regulate mainline pressure up to about 60 psi (Yost et al. 2019). Note that, under higher-pressure situations, an additional frequency drive may be necessary for proper functioning, which adds to the expense.

Crop Germination

Small seed germination can be challenging, particularly in sandy soils or when drip tapes are widely spaced, due to narrow wetting zones created under MDI driplines (Molaei et al. 2022). In these situations, it is recommended to keep existing sprinkler packages in the irrigation system.

Circular Planting in Center Pivots

Circular planting may be required under center pivots to facilitate circular movement of the driplines as well as to avoid possible crop canopy damage. Circular planting is done easily with a GPS-equipped planter (Figure 7A–C).

Potential Tangling of Driplines

Driplines could be blown by the wind and become tangled around the wheels of the pivot. Driplines could also get entangled while reversing the center/lateral pivot. To avoid these problems, it is advisable to allocate additional space next to the towers and reverse the pivot when the drip tube is full of water (i.e., during irrigation). In addition, repositioning of the dripline is sometimes required under high wind conditions or after disturbance caused by grazing and wild animals. It is advised that, during the non-growing season, drip tapes be tied together using a simple tie-up assembly and hung on the MDI manifold for proper maintenance.

Limited Ability for Foliar Application of Chemicals

Because MDI driplines move close to the ground, they offer limited ability to apply fertilizers and chemicals on the leaves and foliage of crops (Figure 7B). However, a hybrid MDI system with sprinkler nozzles can be used for foliar application of chemicals.

Rodent Damage to the Driplines

Several constraints with MDI, including emitter clogging, hose damage by wildlife and rodents, and riding of the hoses above the crop canopy, have been reported by Olson and Rogers (2008). For example, thin-walled drip tapes (5–8 mil) are generally cost effective but highly susceptible to rodent damage. Using a thicker mil tape (15 mil) along with integrated pest management and repellents (castor oil, cayenne) could help in mitigating the damage caused by rodents.

Salt Accumulation

An MDI system effectively delivers water, but localized water application and high evaporation can cause salt accumulation at the edges of the wetting zone and near the soil surface, which can stress plants by hindering water/nutrient uptake. Managing this involves regularly monitoring soil salinity, using low-salt water, ensuring adequate leaching with occasional heavy water applications, using mulch to reduce evaporation, and employing proper fertilization.

Decision Checklist to Determine If an MDI System Is Appropriate for Your Operation

1. The MDI system is appropriate for your operation if:
 - a. Crops are suited to drip irrigation.
 - b. There is a reliable water supply and filtration system that can manage water quality.
 - c. Your field is more prone to runoff and wind losses.
 - d. You already use pivots/linear systems and want to retrofit for efficiency.
 - e. You can commit to maintenance and monitoring.
 - f. You seek water savings, better nutrient efficiency, or improved yields.
2. The MDI system may not be suitable for your operation if:
 - a. Crops or field layouts are incompatible.
 - b. Water quality is poor, and filtration is not feasible.
 - c. Labor or technical expertise for maintenance is limited.
 - d. Upfront costs outweigh expected benefits.

Summary

This publication discusses the benefits and potential challenges of adopting mobile drip irrigation (MDI) technology. The MDI system combines high water-use efficiency of traditional surface drip irrigation with the flexibility and adaptability of center pivot or linear mobile irrigation. By leveraging MDI technology, farmers can optimize crop water productivity and ensure that crops receive the optimal amount of water. This could be an excellent irrigation strategy in water-limited regions for its ability to conserve irrigation water and has the potential to reduce irrigation-driven fertilizer leaching, especially in sandy soils that are prone to leaching. While there are constraints and considerations to properly implement MDI technologies, such as additional filtration systems, planting in circles, etc., MDI's potential benefits make it a valuable precision irrigation tool.



Figure 7. Crop management under mobile drip irrigation. (A) Circular planting by a 4-row GPS planter. (B) MDI dripline alignment in the corn rows. (C) Corn field plots established after circular planting. Credit: Bhimsen Shrestha and Vivek Sharma, UF/IFAS.

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Table 1. Abbreviations of technical terms used in this publication.

Abbreviation	Technical Term
MDI	Mobile drip irrigation
PMDI™	Precision Mobile Drip Irrigation™
MESA	Mid-elevation spray application
LESA	Low-elevation spray application
LEPA	Low-energy precision application
TTIS	Traveling trickle irrigation system
PC	Pressure compensating
NO ₃ -N	Nitrate-nitrogen
BMP	Best management practice
psi	Pounds per square inch
gph	Gallons per hour

Gross Investment (per ha)	Investment Scale	Corn (high water use)	Sorghum/Wheat (medium water use)	Cotton (low water use)
\$185	Small	2.3	3.0	4.2
\$371	Medium	4.9	6.3	9.0
\$556	Large	7.6	9.9	14.6

Table 3. Sprinkler characteristics and major advantages and disadvantages for different irrigation systems.

Pivot Irrigation Systems	Water Application Efficiency Range (%)	Nozzle or Emitter Height from Soil Surface (inches)	Operating Pressure (psi)	Estimated Cost* (\$/acre)	Major Advantages	Major Disadvantages
Mid-elevation spray application (MESA)	70–85	60–120	25	40–80	Canopy cooling. Foliar chemical application.	High evaporation loss. Wind drift.
Low-elevation spray application (LESA)	80–90	12–18	15	50–100	Reduced wind drift. High water application efficiency.	Still chances for evaporation loss.
Low-energy precision application (LEPA)	90–97	0	15	100–150	Higher water application efficiency. No wind drift.	Higher potential runoff. Difficulty in integrating into existing center pivots.

Pivot Irrigation Systems	Water Application Efficiency Range (%)	Nozzle or Emitter Height from Soil Surface (inches)	Operating Pressure (psi)	Estimated Cost* (\$/acre)	Major Advantages	Major Disadvantages
Mobile drip irrigation (MDI)	95–97	0	10	200–400	No wind drift. No runoff. Energy efficient. Easy integration into existing center pivots.	Higher upfront cost. Higher maintenance cost.
*Costs are estimated excluding the costs for pivots and vary depending on suppliers, pivot size, and any other additional requirements.						

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