Agriculture

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Small Acreage Irrigation System Selection

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Irrigation has been an essential part of Utah's agricultural production since pioneer days. Utah's 1.3 million irrigated acres are primarily watered with surface irrigation methods. About 40% of the irrigated area is under sprinklers. Low flow or micro-irrigation such as drip emitters, drip tape, and micro-sprinklers irrigate a small portion of the total area. Low flow irrigation is mostly used in orchard, vegetable, and ornamental growing areas.

Irrigation Systems

A complete irrigation system includes the water source, conveyance facilities, field application method and provision for drainage of excess water. Streams, surface reservoirs, municipal water supplies, and wells are common irrigation water sources. Important questions for you to ask about your source of water and site conditions are:

What is your water right?

Water rights in Utah, as in other western U.S. states, are founded on the doctrine of "prior appropriation" and are administered by the State Engineer. All waters are public property in Utah (UT Water Rights, 2005). A ***water right*** is a right to the use of water based upon 1) quantity, 2) source, 3) priority date, 4) nature of use, 5) point of diversion and 6) physically putting water to beneficial use (http://www.waterrights.utah.gov).

What is your water source, supply amount and pressure?

Canals and ditches are the most common irrigation water sources in Utah. The use of pressurized irrigation pipe lines is increasing, often in suburban areas as a secondary water supply. Trash exclusion (water filtration or screening) is a concern with surface sources supplying sprinkler or drip irrigation systems since plugging of nozzles and emitters is a common maintenance issue.

As Utah becomes increasingly urbanized, more small acreage water is being supplied by municipalities. These suppliers deliver a set amount of water for a monthly fee. Municipal water pressure is fairly constant and is not usually a concern, except with drip systems where pressure may need to be reduced. Using culinary water for irrigation can be expensive if it exceeds the monthly allocation covered by the base fee. More efficient application methods, such as drip, may be a good investment when water is expensive or limited.

If your water is delivered through a canal or ditch, how many shares does it take to irrigate your property and when is the water available?

There are about 1,000 irrigation or canal companies in Utah. The amount of water in a share varies considerably from one irrigation company to another. Thus, the number of shares needed to adequately irrigate an acre of land will vary with the irrigation company. Water is usually measured in Cubic Feet per Second (CFS). A flow rate of 1 CFS for 1 hour will cover an acre with 1 inch of water. Most crops use about 30 inches of water per season, however 40 to 50 inches of water is commonly required because of inefficiencies in the irrigation system. Thus, to know whether you have adequate water you will need to determine the flow rate of the water you will be receiving and the amount of time it will be available to you. The water is generally available on "turns" rotated in sequence down the ditch.

The interval between successive turns commonly varies from one week to 14 days.

What is the quality of your irrigation water, particularly the salinity?

Salt content is measured as Electrical Conductivity (EC) in units of decisiemens per meter (dS/m) or millimhos per centimeter (mmhos/cm). Both units of measurement are equivalent. The higher the salt concentration of the water the easier an electrical current passes through it. Generally, water used for field crop irrigation should have an EC of less than 2.0 dS/m (Hill and Koenig 1999, Kotuby-Amacher, Koenig, and Kitchen 2006). The local irrigation company will usually have water quality data on their water source. The Utah State University Analytical Lab (http://www.usual.usu.edu) can provide an irrigation water quality analyses. Contact your local Extension Office for information.

How should you irrigate your property?

The answer to this question requires considering your economic situation, the need to conserve water, and your personal preferences along with the physical realities of the site; slope and levelness, water intake rate of your soil, length of the field, crops grown, water source, water table, and soil salinity. The most common irrigation method for small acreages in Utah is surface (flood) followed by sprinkler. As the population grows, there is an increasing demand for the limited water resources available. This has raised the general awareness of the need for water conservation. Thus the use of low flow irrigation methods is slowly growing.

Soil salinity and non-usable wet spots can often be improved with proper drainage. The need for surface and/or subsurface drainage is indicated by high water tables or wet spots in the field. Also, changing from flood irrigation to sprinklers will usually help with salinity and high water table problems.

Factors to Consider in Selecting an Irrigation Method

Relative advantages and requirement of some common irrigation application methods are given in Table 1. For example, surface irrigation methods (furrow, border, and level basin) are more suitable to land that is relatively flat with a uniform slope. Surface irrigation methods require very little energy (head) compared to sprinklers or drip and are lower in initial cost. The main reason the water salinity level needs to be “low” for sprinklers is the potential for leaf damage from foliar application of “salty” water.

The irrigation method used for a specific small acreage situation is largely determined by the size and shape of the site, water supply, labor availability, and cost. Further discussion of each of the three main application methods is in the following sections.

Table 1. Comparison of Irrigation System Characteristics (Adapted from Neibling, 1997)

FACTORS	SURFACE SYSTEMS			SPRINKLER SYSTEMS				DRIP
	Border	Level Basin	Furrow	Hand Line	Wheel Line	Center Pivot	Big Gun	Drip
Slope Limitations								
Direction of irrigation	0.5 – 4%	Level	3%	20%	15%	15%	15%	None
Cross slope	0.2%	Level	10%	20%	15%	15%	15%	None
Intake Rate Limitations (inches/hour)								
Minimum	Moderate	Moderate	Moderate	None	None	Moderate	Moderate	None
Cost								
Initial	Low	Low to moderate	Low	Moderate	Moderate	High	Low	High
Operation/labor	High	Low	High	High	Moderate	Low	High	Low
Water Quality Limitations								
Salt level (ability to handle)	High	High	Moderate	Low	Low	Low	Low	High
Water Required								
Rate of flow	Moderate	Moderate	Moderate	Low	Low	High	High	Low
Availability	Periodic	Periodic	Periodic	Continuous	Continuous	Continuous	Continuous	Continuous
Conservation								
Irrigation Efficiency	Low	High	Low	Moderate	Moderate	High	Low	Very High
Energy Required								
Head (feet of water)	1 – 5	2 – 5	1 – 5	140	140	65	185	45
Pressure (psi)	NA	NA	NA	40 0 55	40 – 55	25 – 30	55 – 65	10 – 20

Characteristics of Irrigation Methods

Surface Irrigation

Proper management of surface irrigation may be more of an art than a science. It is also often more labor intensive than other irrigation methods. Flood irrigation application methods include; wild flood (letting the water run with no confinement mechanism), border (confining the water between two dikes), furrow (uniformly spaced small ditches), and level basin (dike surrounded flat basin which is rapidly covered with a uniform depth of water at each irrigation). One of the most common water supply methods for flood irrigation is to place a plastic or canvas dam in the head ditch to back the water up, and then a cut a notch in the ditch to let the water out for a specific area of the field. Each time the dam is moved and reset is called an irrigation 'set'. Many variations of this method are used, such as screw open valves (alfalfa valves), slide open gates (head gates), siphon tubes and gated pipe.

The application efficiency (% of water delivered that ends up in the root zone of the crop) of surface irrigation systems varies from as low as 15 to 20% with wild flooding to as high as 85-90% with level basins. Deep percolation and run off are common water losses with surface irrigation systems. Generally the greater the control over water movement and the more precisely level (or graded) the field is the higher the application efficiency. With surface irrigation it is difficult to obtain uniform water distribution on fields that are long or have coarse textured soils (gravel or sands) due to the time it takes for the water to travel to the bottom of long fields and the high intake rate of coarse soils. Management of surface irrigation requires being there to "tend" the water, i.e., to move the water to successive application points as it reaches the end of the run. Water that is not properly tended may move off of the field and enter basements and neighboring properties. Also, the amount of area watered with each set may need to be adjusted to match the amount of water flowing in the supply ditch during that particular irrigation.

Sprinkler Irrigation

Sprinklers can be a good investment when properly designed, installed, maintained, and managed. Sprinkler application methods include; hand line, wheel line, solid set, center pivot, big gun, and end tow (lines of sprinklers which are towed to the next desired location) systems. Sprinklers apply water more efficiently and uniformly than typical surface irrigation systems, thus they produce more crop yield for each acre-foot of water supplied.

Water discharged from a sprinkler into the air should infiltrate the soil where it falls, there should be no runoff. For high uniformity of wetting, the spray patterns from adjacent sprinklers must properly overlap. Generally, in a full coverage situation, the spray from

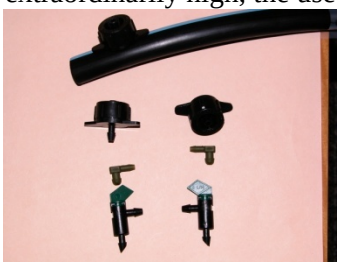
one sprinkler head should reach the adjacent sprinkler heads. Evaporation, wind drift, and deep percolation are the chief causes of water loss from sprinkler systems.

Sprinkler irrigation is suitable for almost all crops and is a good choice for fields that have varied soils and topography because the uniformity of water application is independent of surface variations. Where soils have low water intake rates, lower discharge nozzles can be used or the length of time the sprinklers operate at each setting can be adjusted to reduce runoff. Sprinklers are convenient for small acreage situations, but do require a continuous supply of water during operation. Small amounts of water (0.5 to 2 acre inches per acre) can be applied more uniformly with sprinklers than with surface methods. Thus, sprinklers are suitable for coarser textured soils and shallow rooted crops.

Low Flow (Drip) Irrigation

Low flow or micro-irrigation methods include drip (individual emitters apply water to the soil surface), micro-sprinkler (water is sprayed over a small area close to trees or shrubs), bubbler (stream of water is applied to small basins near individual trees), and subsurface drip (emitters apply water below the soil surface). Relatively small amounts of water can be precisely applied with low flow or micro-irrigation methods. Thus, low flow irrigation is adaptable to almost any soil; however it is particularly valuable on very coarse low water holding capacity soils where daily or more frequent irrigation is needed. A continuous supply of water is required during operation of the low flow system. Due to the small opening size of the emitters, supply water needs to be adequately screened or filtered to eliminate clogging.

The initial cost of low flow systems is relatively high, thus usage is usually limited to higher value crops. Of course, if the amount of water is limited or its cost is extraordinarily high, the use of low flow methods may be a good investment. Low flow (drip) irrigation may be the only viable option for crops grown on steep slopes and gravelly soils. Low flow irrigation is also suitable for small and odd shaped parcels, for windbreaks, trees, vines, vegetables, and shrubs.



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Additional information on irrigation is available on the Utah State University web site at: http://extension.usu.edu

Select “Publications” and then select “Irrigation Engineering.”

WHERE CAN YOU GET HELP?

Utah State University - Extension Service

Utah Counties – Extension Office see: http://extension.usu.edu/counties for directory.

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