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Small Acreage Irrigation System Operation and Maintenance

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CHARACTERISTICS OF IRRIGATION METHODS

Surface Irrigation

Surface irrigation includes flood (sometimes denoted "wild flood," as in uncontrolled), furrow, border, and basin. Surface irrigation operation and maintenance may be more of an art than a science. It can also be more labor intensive than other irrigation methods. Proper design of surface irrigation systems takes into account the soil type (texture and intake rate), slope, levelness of the field, stream size, and length of run. It is generally more difficult to obtain high uniformity of water distribution in long fields on coarse textured soils (gravel and sands) than on fine textured soils (loams to clay).

Sprinkler Irrigation

Sprinklers are any of numerous devices for spraying water over the soil surface. They include impact, rotators, sprays, and wobblers and may be made out of brass, plastic, or zinc. Field systems include hand move, wheel move, center pivot, solid set, drag line (such as K-Line™), and water cannon. Sprinklers can be a good investment when properly designed, installed, operated, maintained, and managed.

Water from a sprinkler discharged into the air should infiltrate the soil where it falls, but it should not saturate the soil surface to the point of ponding and/or run off. For high uniformity of wetting, the spray patterns from adjacent sprinklers must be properly *overlapped*. This generally means that the water sprayed from one head reaches the adjacent spray heads. Evaporation, wind drift, and deep percolation are chief causes of water loss.

Sprinkler irrigation is suitable for almost all crops and is a good choice for fields that have varied soils and topography because the depth of water application is independent of surface variations.

If runoff is occurring, the rate of application should be reduced to match the rate of soil water intake. 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 (Micro or Drip) Irrigation

Low flow or micro-irrigation methods include drip (individual emitters apply water to the soil surface), micro-spray or micro-sprinkler (water is sprayed in a small area close to trees or shrubs), bubbler (stream of water is applied to small basins by 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 or micro-irrigation is adaptable to any soil type where daily or more frequent irrigation may be required. However, a continuous supply of water is required during operation. Due to the small opening size of the emitters, supply water must be adequately screened or filtered to eliminate clogging. Low flow or micro-irrigation is suitable for individual trees and shrubs, fruit crops, vegetables in beds or rows, and other high-value crops, but not generally for field crops such as alfalfa, grain, and pasture, due to the high installation cost.

OPERATION

Good operation of any irrigation system includes matching the irrigation duration with the rate of application and the intake rate of the soil to maximize the fraction of water stored in the root zone. Field irrigation (application) efficiency is the ratio of water stored in the root zone divided by the water delivered to the field. For example, if 5 inches of water are delivered to an acre during irrigation and 3 inches are ultimately stored in the root zone, then the application efficiency (Ea) is 60% ($60 = 100 \times 3/5$). In this example, since volume equals area times depth and the area is one acre, the equivalent volume of water delivered is 5 acre-inches. If a field is under-irrigated, all the infiltrated water could be stored in the root zone, giving an apparent high irrigation efficiency even though the water distribution uniformity across the field may be poor. Conversely, an over-irrigated field will have low irrigation efficiency, even if the irrigation was very uniform, because of the deep percolation. Thus, knowledge of the soil moisture content prior to irrigation is essential to maintaining high application efficiency while providing sufficient water for optimum crop growth.

Surface (Flood, Furrow, Border)

Operation 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. Adequate water application from the top to the bottom of the field can be realized if the water in furrows reaches the end of the field within one-quarter of the planned irrigation duration. For example, if the irrigation is planned to take 12 hours, then the water advance to the end of the field should be accomplished in 3 hours. Once the water reaches the end of the field the application rate at the top of the field should be cut back to avoid excess loss of runoff water. Where possible, the supply stream flow to the furrows should be adjusted to match the intake rate of the field. This could be accomplished by spreading the water over more or fewer furrows or borders. Some tail water runoff is inevitable if the bottom of the field is to be adequately irrigated; however, it should be minimized. If possible "capture" runoff water and reuse it in lower fields.

The use of border irrigation changes the operation from that of furrows in that a "sheet" of water moves across the field. The supply stream should be moved to the next border prior to the advance reaching the end.

Sprinkler

To realize the full benefit of the sprinkler system, it must be operated according to design. The nozzle size, available pressure, and set duration should produce an application rate that matches the intake rate of the soil and evenly distributes the amount of water needed to refill the depleted soil water in the crop root zone.

To achieve a uniform application, the sprinkler spacing or move distance may need to be adjusted to compensate for variations due to wind or exceptionally hot days. This may involve special operating techniques such as using an offset hose or alternating between day and night on successive irrigation cycles to improve distribution uniformity. Where pressure differences, within a sprinkler system, result in low water application uniformity, special hardware such as flow control nozzles or pressure regulators may be required.

Low Flow (Trickle or Drip)

The supply water must be screened or filtered to reduce or prevent drip system emitter clogging. Depending on the amount of debris (silt, sand, and/or trash) in the source water, the filters or screens may need servicing daily or more frequently. This is a particular concern when water is supplied from an open ditch or canal. The frequency of cleaning the filters may be greater in the spring when more debris is in the water.

Operating pressure. Low-flow systems are designed to operate with low pressures, usually 15-25 psi. Fittings and connections are not designed to handle the higher pressures of household or culinary systems. Be sure to operate within the design specification of your system. Inexpensive pressure regulators can be used to keep your water pressure within the desired range.

Emitter placement and flow metering. Low-flow systems place water very accurately. Depending on the soil type, the water may spread over an area of more than 24 inches in diameter (12 inches from the emitters). In order to get the water to spread out, it is important to not cycle the system. The water needs to be discharged continuously to assist the capillary action of the soil to spread the moisture horizontally. Since low-flow system designs do not typically have surface water runoff problems, cycling the system is not usually needed. Medium coarse to coarse soils have a weak capillary action so the water will not spread out as much. Emitters in coarse soils will need to be closer together. A general rule is to space emitters 12 inches apart in sandy (light) soils, 18 inches apart in loamy (medium-textured) soils, and 24 inches apart in clayey (heavy) soils.

Low-flow systems may be automated. The length of time for running the system depends on the soil type, emitter flow rate and depth of the root zone. Since low-flow systems are measured in gallons per hour (gph), it is helpful to know that 0.62 gallons of water will provide one inch of water on one square foot of soil surface. Thus, if the area being irrigated is 100 square feet and the desired amount of water to apply is 1 inch, then the system should apply 62 gallons of water to the target area. (Formula = inches of water to apply X square feet to cover X 0.62)

For large plants, such as trees and shrubs, that have a large root system, a micro-sprayer or bubbler may be more appropriate. Flow rates will typically be fairly high for bubblers or micro-sprayers. Regardless, it is important to supply enough water to wet the root zone, both horizontally and vertically, with the top 12 inches being most critical. With large trees and shrubs it is especially important to place emitters or micro-sprinklers over the entire root zone and not just at the trunk or base.

MAINTENANCE

Proper maintenance involves anticipating the need for repairs and replacement of worn mechanical parts and damaged or broken pipes. Spare parts of commonly needed items should be kept on hand for emergencies. Periodic inspection of supply ditches or pipes, mechanical equipment (such as pumps, nozzles, emitters and filters) and distribution systems should be made throughout the irrigation season. It is a good idea to perform preventative maintenance in the fall, winter, and/or early spring in order to be ready for the next irrigation season.

An audit or evaluation of the irrigation system is recommended if you suspect that the system is not as efficient as it should be. An audit determines the depth of water being applied, and distribution uniformity. If a pump is used, it is tested to determine fuel or energy use efficiency. Contact your local county extension office for more information about irrigation system audits. See also: http://www.slowtheflow.org/watercheck/default.aspx

Surface (Flood, Furrow, Border)

Ditches should be cleaned out at least annually and more often if needed. A shovel can be used to clean smaller ditches. A mechanical ditcher and tractor is very helpful on larger ditches. Often ditch cleaning is an early spring "rite" to be completed prior to the first delivery of water. Many irrigation and canal companies require that shareholders maintain their own head gates and keep them in good operating condition. In areas where rodent damage is a problem, "tromping gopher holes," or otherwise fixing leaks in ditches may be a daily chore. Periodic re-leveling of surface irrigated fields may be needed to compensate for soil settlement or consolidation over time.

Sprinkler

Regular maintenance of sprinkler equipment will reduce repair costs, help the system last longer, and keep irrigation efficiency at design levels. Each manufacturer provides guidelines and manuals for equipment operation and maintenance. Such information is the preferred source and should be referenced when performing irrigation equipment repair and maintenance.

Sprinkler systems should be inspected and any necessary repairs completed prior to the start of the irrigation season. All irrigation systems should receive special attention at the end of each irrigation season. During the fall, while water is still available for operation, it may be a good idea to run the sprinkler system and look for problems. This will allow you to plan for any needed maintenance well in advance of the next irrigation season. Check all nozzles for plugging, mismatched sizes, breakage, corrosion or other damage caused by wear. Couplers and connections should be checked for leaks and repairs/replacements should be completed as soon as possible. If a sprinkler system has been properly prepared for winter storage, spring maintenance is much easier. Often local irrigation supply companies provide a fall or winter tune-up service at a reasonable cost. If the field is used for pasture, careful attention should be given to protecting the irrigation system from livestock damage.

Low Flow (Trickle or Drip)

Flush the system at the beginning of the growing season and check to be sure the emitters are not clogged. Do this by opening the ends of the tube and running clean water through the system, starting with the lines closest to the supply source. Once the tubes have all been checked and sealed again, check for flow from each emitter. Regular flushing of the system throughout the season may be necessary depending on the cleanliness of the water supply and filtering system. This will help remove larger mineral and organic matter particles that can clog emitters.

To keep the small openings in low-flow systems from becoming clogged, the water source must be properly filtered. The cleanliness of the irrigation water will determine how often the filters should be checked and cleaned. For systems that use culinary water this may mean only a couple of times during the growing season. A 150-200 mesh screen will generally be adequate. For secondary water systems, supplied from a ditch or pond, it may mean daily. If continual clogging is a problem, it may be necessary to select finer screens or use a sand filter or chemically treat the water.

Check the filters regularly and frequently until the best cleaning schedule for the system can be determined. The frequency of cleaning the filters may be greater in the spring when more debris is in the water. Back flushing, or removing the filters and washing them out backwards is the most common way to clean most filters. Replace the filters when they get holes or openings too large to filter out damaging or clogging particles.

Organic matter slipping past the filter or algae growing in pipes or fittings may cause serious system problems, especially when the source is a secondary water system. Opening the end of the system and flushing will help remove organic matter. If algae growth is a problem, chlorine can be used to kill the algae. Applying a concentration of 10 to 20 ppm of chlorine for 30 to 60 minutes should solve most algae problems. After the algae has been killed it will need to be flushed as described above.

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Additional information on wheel move sprinkler management is available on the Utah State University Web site at: http://extension.usu.edu

Select "Publications" and then select "Irrigation Engineering"

List # Title and year published:

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38 Wheelmove Sprinkler Irrigation Operation & Management – ENGR/BIE/WM08 Aug 2000

WHERE CAN YOU GET HELP?

Utah State University - Extension Service

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

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