NRCS MONTANA - IWM - SPRINKLER IRRIGATION

What is Irrigation Water Management (IWM)?

Irrigation Water Management (IWM) is managing the rate, amount, and timing of water application according to the seasonal crop needs, giving consideration to the soil intake and water holding capabilities. The application frequency and water quantity used are managed to obtain optimum yields, using the appropriate amount of water based on soil moisture and crop water use.

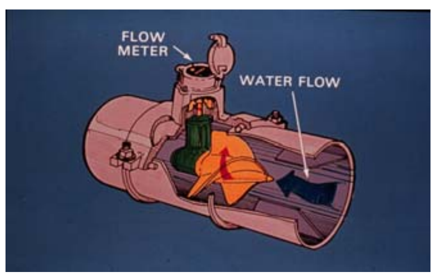
Soil and Water Resources

In most cases, IWM reduces water loss due to deep percolation, runoff, evaporation, system leaks, or seepage. It takes advantage of any effective rainfall.

Sprinkler applications that exceed the soil intake, can cause runoff, erosion, and deposition of sediment along with attached nutrient transport.

Requirements of Irrigation Water Management

The adage "You can't manage what you can't measure" is very true in irrigation. It is the starting place for every irrigation set. There are many types of flow measurement meters that can be used to determine the amount of water delivered to a sprinkler system.



Propeller-type Flow Meter

Many are a type of propeller that is placed into the pipeline flow, which displays a reading in gallons per minute. The flow rate is shown on a dial gauge having a needle pointing to the GPM, or with digital readout. Most measurement devices have less than 5% error when properly installed and used. Knowing the flow rate available, the next step is to determine the existing soil moisture at the time of irrigation.

Soil Moisture Measurement Methods and Tools

With practice, many irrigators can develop the skill to determine the approximate soil moisture in a given soil layer by using feel and appearance. When re-filling a selected depth of root zone during a set, such as done with wheel roll laterals, a rough estimate of moisture in several soil layers may be adequate.

A photographic brochure called "**Estimating Soil Moisture by Feel and Appearance**" is available from local Conservation Districts and NRCS Field Offices.

With the development in pivot sprinkler technology of precise low-pressure application methods, such as LESA, MESA, and LEPA, (see explanations under Pivot Sprinkler) more precise tools need to be used to determine the required soil water available to manage. An easy to use, inexpensive tool to keep track of existing soil moisture in sandier soils is the tensiometer.

Tensiometers can be "nested" together in a field at two or more depths, to check the full root zone.

Moisture lost or gained in the soil is transposed to a tube through a ceramic tip on the end of the tube. Vacuum pressure within the tube is measured by a pressure gauge as water from the soil fills or leaves the tube. Gauge readings are calibrated to soil moisture levels.

The resistance block is another easy to use tool. Electric wire contacts are imbedded in a ceramic or similar material block. The blocks are buried into the soil at two or more depths and "nested" at one or more locations in the field. The wire leads extend to the ground surface, for connection to a portable resistance meter. The meter measures a current passed through the block reflecting the resistance variations of moisture held in the block.

Other sophisticated sensors using capacitance, heat dissipation and other techniques are available as well.

Soils Information

Without restrictive layers, root development and water extraction take place as shown in Fig. 1. About 40% of the crops water extraction occurs in the upper quarter of the root zone, 70% in the upper half of the root zone.

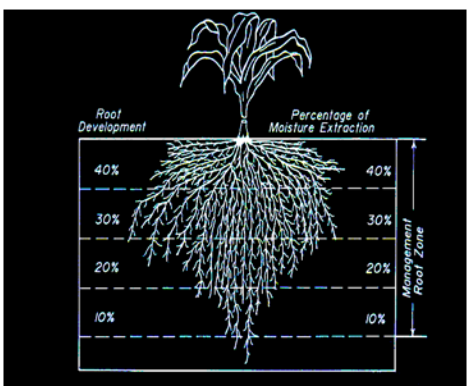


FIGURE 1

A restrictive soil layer such as a plow pan, heavy clay, or coarse gravel may reduce root zone development.

At times of limited water availability, adjusting your irrigation set times to infiltrate only one-half to three-quarters of the developed root depth, will reduce loss to deep percolation beyond the root zone. BUT, remember if you irrigate to a lesser depth, you will need to irrigate one or two additional times during the year.

Table 1. Approximate available water capacity for various soil types.

SOIL TYPE	Available water in upper 3 feet of soil profile (inches)
Silty clay and clay	4.9
Silty clay loam or clay loam	6.9
Silt loam over Silty clay, or Clay	5.2
Silt loam	7.1
Loamy sand	3.8
Fine sand	2.8

Typical IWM rooting depths for crops grown in Montana vary from 30 to 60 inches. NRCS recommends the use of a Management Allowed Depletion, (MAD) of 50% of the soil available water holding capacity before an irrigation set begins (except for potatoes and dry beans). This 50% MAD works well for sets using Wheel Roll and Big Gun sprinklers. For example, using Table 1 above for a grain crop (3 foot rooting depth) in a clay soil, irrigation should begin before the crop consumes 2.5 inches. (50% of the 4.9 inch available water).

Pivot Sprinklers

There are many types of pivot and linear sprinklers available. In addition to those using impact sprinklers, there are various low-pressure units using rotating stream or spray heads at various levels of the crops.

Sprinkler head levels are: above the crop canopy, Mid Elevation Spray Application (MESA), Low Elevation Spray Application (LESA), and Low Pressure In Canopy (LPIC) systems. LEPA, Low Energy Precision Application systems, which place water on the ground through drag socks or "bubblers" at 18 inches or lower, are rare in Montana.

Each of these pivot sprinkler types requires very accurate soil moisture monitoring. Since most of these systems are designed to apply an inch or less in a 24-hour period, if seasonal irrigation begins with less than a nearly full potential root zone, the irrigator may not be able to keep up with the crop's peak consumptive use. Once behind, the system may not be able to keep up and supply the daily crop needs, particularly on windy and hot days when application efficiency is reduced.

Drought and Limited Water Sources

IWM is particularly important during dry years, or where water is in limited supply. Knowledge of critical crop growth stages and water availability to meet plant needs can maximize production. Measurement of flow is a "must" under these conditions. Water application at the same rate throughout the irrigation season may not provide adequate water for best plant production. Consideration of water available, the root system development (Fig.1), and critical crop growth stages for water application, will use less water throughout the season.

Late season runoff, particularly during low water years may be high in salinity content. This will require water management changes to reduce salt build up in the soil that may lead to decreased production.

In the table below is information that is specific to the site and irrigation system for which you recently requested assistance from NRCS. There may be more information as well, so don't be afraid to ask at the local office.

CROP ROOTING DEPTHS
GRAIN__________ ALFALFA _____________ ____________________
CORN __________ POTATOES ___________ ____________________
SPRINKLER SYSTEM FLOWRATE (GPM) ____
GROSS WATER APPLICATION / SET TIMES ______________________________________