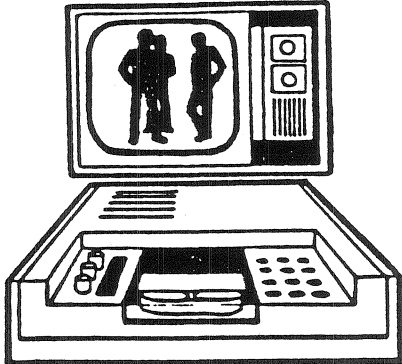


IMPROVED IRRIGATION MANAGEMENT

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In 1985 a film and video production series on applied soil and water topics was initiated. The irrigation series addresses the extension needs of all our farm clients and peers through resourcing group activities and mass media. The principles advanced are based on Saskatchewan conditions and the staff training I have delivered over the past decade.

Jim Burke, Audio-Visual Specialist with Saskatchewan Agriculture, Patti Townsend and Ian Preston were key members of the production team. As well, Brian Duchscherer's animation and graphic design is recognized for innovatively displaying the soil-water relationship.

PLAN TO PUMP

One of the most important requirements of any plant is water. In the case of agriculture lack of water is one of the most common complaints and unpredictable weather the most common risk.

Farmers often wonder if the province's water resources could be tapped. More and more producers are doing just that through the use of various irrigation systems. Irrigation has many benefits. Crops not able to survive under rainfed farming conditions may be grown under irrigation. Irrigation eliminates the hazards of drought, and makes use of sandy soils not otherwise suited to dryland cash crops. It should also mean higher net returns per acre. However, for all these benefits to be realized the systems must be used. Irrigation is not an insurance policy to be used when the weather fails. Farmers must plan to pump.

The initial investment in a sprinkler irrigation system is high. In Saskatchewan many irrigators use what is known as wheelmove systems. Sprinklers are spaced on lateral pipelines mounted on steel wheels. The system must be mechanically moved in the field between irrigations. The capital cost of a wheelmove irrigation system ranges from \$450.00 to less than \$350.00 per acre as projects increase in size beyond 100 acres.

Center pivot irrigation is becoming more and more popular. There is much less labour required for its operation, but the initial investment is much higher. The system is comprised of a lateral pipeline mounted on high towers and attached to a point in the center of the field. The system pivots about that center point, watering in a circular pattern. Since each sprinkler on the lateral covers a different area, computer design is applied to pattern uniform watering. The capital cost of a pivot system ranges from 60 thousand to 80 thousand dollars per quarter section of land.

Considering the high initial cost of an irrigation system it is advisable to use it. The added returns from irrigated land have to justify the initial expenditure.

Under optimum irrigation and good management, hard red spring wheat will yield 55 bushels per acre. Soft white spring wheats should come in at 70 bushels per acre, barley at 90, canola at 45, and alfalfa should yield 4 and a half tons per acre. Average yields under irrigation, however, rarely achieve these objectives.

Even with normal rainfall, alfalfa requires a minimum of 12 hundred hours of irrigation in its growing season. Silage corn and fababeans require 1000 hours. Soft and medium wheats, mustards and Argentine canolas require 950 hours of irrigation. Eight hundred and fifty hours is the bare minimum for hard spring and durum wheat, malting barley, canary seed and Polish canolas, while flax and lentils require 750 hours of irrigation in a season.

Research has shown, however, that in 1983, a relatively good year, irrigators with unlimited water supplies only pumped water for an average of 583 hours. In 1984, a year of serious drought, sprinklers were only on for an average of 1004 hours. In fact, in June 1984, for every sprinkler irrigating, two were idle. The result was a depletion of soil moisture reserves, and in many cases, a reduction in yield.

Many producers hesitate to have their systems on for those extra hours, anticipating high operating costs. However, in comparison to the initial investment, operating costs are not high.

An extra inch of water may make a big difference in crop performance and moisture reserves, and cost only one to two dollars per acre.

The typical sprinkler irrigation system has its limitations. It provides about a quarter of an inch of water during a 24 hour period. Short periods of irrigation do not provide enough water to encourage good root development and do not add sufficiently to the moisture reserves.

So when budgeting for another year of irrigation, remember the minimum pumping time required for your selected crop. Remember the target yields you are budgeting for; remember the limitations of your system, and plan to pump.

KNOW YOUR SOIL

The relationship between soil and water controls plant growth. Knowing how water behaves in the soil is the basis of any good irrigation program. In order to provide the right amount of water in the right place, at the correct rate and at the right time, irrigators must "know their soil".

Water in liquid and vapour forms are always moving in the soil. It moves downward after rain or irrigation, it moves upward to evaporate, towards and into plant roots and even horizontally from wet to dry soils. It moves through pores or spaces between soil particles, much like ink moves in blotting paper. How water moves is determined by the forces acting on it, and by the pore space in the soil.

Gravity acts on water to pull it downward through the soil. The forces which hold water in the soil are called adhesion and cohesion. Adhesion is the force which attracts water to soil particles. Cohesion is the force which holds water to itself.

In a sandy soil, one with large pores, the force of gravity is dominant. Water will quickly move through it.

The pores in a fine textured or clay soil are very small. However, there are many more of them than in a coarse soil. Because the pores are smaller, the forces of adhesion and cohesion are much stronger, and water is held for a longer time. Clay soils are better suited to dryland farming because they hold more water. However, coarser soils are more suited to irrigation because water moves freely in them.

Irrigated fields are rarely one uniform soil texture. Many fields are stratified, that is one soil type over another. Stratified soils change water movement patterns in the plant root zone.

An example is a layer of fine soil over a layer of sandy soil. The water moves through the fine layer, but does not move into the sand until the fine soil is nearly saturated.

A clay layer under a sandy layer can cause problems with drainage. The water doesn't progress through the clay layer as quickly as it moves through the upper layer of sand. Water could build up to form a water table or slough above the clay.

There could be many different soil types stratified in a quarter section. Water will behave differently in each type, and irrigation decisions have to be based on that judgement.

The rate at which water moves into the soil is the intake or infiltration rate. The infiltration rate for sandy soils is relatively fast and even. In clay or fine textured soils water penetration is slow. This creates puddling and uneven penetration with some runoff.

Putting water on a field at a rate higher than the soil's intake rate could result in high runoff. That is a waste of irrigation dollars, and if it continues, could drown portions of the crop.

In order to get an idea of how water moves and is held in the soil, it is advisable to measure soil moisture.

Scientists most commonly use the gravimetric method of measuring soil moisture. Soil samples are taken at different depths. The soil is weighed, dried and then weighed again. The difference in the weights is the moisture content. It is expressed as a percentage by weight.

Other more sophisticated methods are also used to measure soil moisture. A neutron probe uses a radioactive source. It is lowered into a hole in the soil. Neutrons are released by the source. Water slows the neutrons and the probe counts the number of slowed neutrons in a set time period.

A tensiometer is a mechanical plant. It measures suction created by the forces holding water in the soil. The roots must exert a slightly greater suction to move moisture and nutrient into the plant.

A soil moisture block indicates electrical conductivity in the soil. As the soil dries there is an increasing resistance to the flow of electrical current. The block readings are calibrated in terms of available soil moisture.

With a little practise, soil moisture can be measured manually, or by feel. For example, all soils at field capacity will form a ball when squeezed tightly. They will leave a wet spot on the hand, but will not drip. Field capacity is normally observed in the topsoil 24 hours after irrigation.

Sandy soils, where 50% of the available moisture has been removed, appears dry and crumbly. Samples with more clay content will form a weak ball. At this point crop moisture stress becomes a yield limiting factor.

Regardless of how the moisture is measured, it is important to take soil samples that represent the range of field conditions. They can be taken with a spade or a soil probe. Samples should be taken through the entire root zone, which in the case of most crops is the top three feet of soil.

The soil and its relation to water is one of the most important factors in irrigation management. So polish up your soil probe, and know your soil.

TURNING OFF THE TAP

In August, Saskatchewan's irrigation season is considered to be over. Most of the systems have been turned off. It is during this time before harvest that many irrigators take a long awaited holiday. However, after the system is turned off, some crops may take a turn for the worse. Heads may not be as full and kernels not as plump as expected.

Some crops under irrigation have more than likely suffered stress from a lack of moisture during the latter part of the growing season. There are ways of preventing that. It all comes back to when to turn on and off the tap.

To avoid late season stress, irrigation could have continued later into the month of August, virtually eliminating a much deserved break. However, looking even further back in time, better irrigation scheduling could have taken place early in the irrigation season.

Until mid June, climate and crop use allows the design of a typical sprinkler irrigation system to easily meet the moisture needs of a crop. It can also substantially boost moisture reserves in the soil. Early irrigation can put moisture into dry soil to levels that would not be reached by fall and spring precipitation. However, in late June and through July, limitations of sprinkler systems come into play. Without significant precipitation, to supplement the system, wetting front penetration cannot be maintained.

Ideally, cereals and oilseeds should receive between 17 and 19 inches of water during the growing season. Assuming normal precipitation and normal subsoil moisture, eight or more inches of that moisture should come from irrigation. The critical time for moisture is during the shot blade and through seed formation. The safe level of moisture depletion is 50 percent of the available soil moisture. Only that half is readily available for plant use.

The wetting front, or moisture in the soil has been known to recede more than three inches in July. Wetting front penetration varies in most cases from 12 inches or more in June to nine inches or less for most of July.

In June, water is readily available to plants in the upper root zone for about four days. However, that reserve, the irrigator's safety margin, drops to about two days in mid July.

Below the wetting front, root activity creates a dry zone where there is virtually no available moisture. In this zone plant roots become dormant. This dry zone extends to greater depths from late June through August until the crop is swathed.

Irrigation scheduling is commonly done by knowing how much moisture is available in the root zone, and by knowing how much of the moisture can safely be depleted. Again the rule of thumb is half of the available moisture. Agricultural research has determined the normal moisture use by the crops. Temperature, evaporation and other weather conditions are also considered. A good knowledge of the crop and the soil textures in the field is also essential.

Targetting for moisture penetration to 24 inches is an innovation in irrigation scheduling. By carrying a larger moisture reserve through June and July, the dry zone is decreased in size. That leaves a better moisture reserve in the latter part of the irrigation season. For most annual crops, that means the tap can be turned off earlier in August. It is extremely important that soil sampling be carried out to monitor wetting front penetration.

On the other hand, frequent shallow wetting fronts can produce expected yields with a little luck. However, late season stress is almost inevitable. Even worse with this type of management, there would be serious crop loss that would result from a mechanical break down in July.

Targetting for a 24 inch wetting front penetration has been proven effective. Most Saskatchewan irrigators however, don't use this strategy to provide early moisture reserves. In fact between June 11 and July first, our pivot irrigation systems are only running about one-third of the time in a 24 hour time period.

By irrigating more in the early part of the growing season, irrigators provide additional summer moisture reserves. By striving for uniformity in an irrigated field an irrigator will get the most from his fertilizer and other inputs. By sampling and monitoring water movement, irrigators will know exactly when to turn off the tap.

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