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Off-Season Management Tips

Pre-plant Irrigation Management

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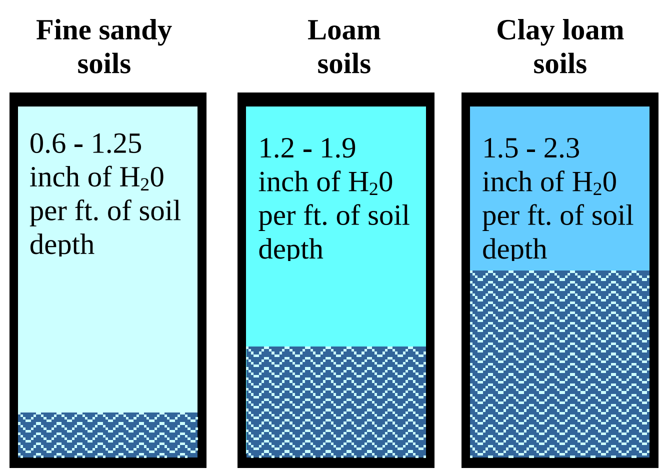
Pre-plant irrigation is common practice in the South Plains. Although high fuel costs will certainly affect these irrigation decisions, you can't rely solely upon winter and spring rainfall to moisten soil for field preparation, seed germination, and early crop establishment. Pre-plant and early season irrigation is needed to facilitate crop establishment. This will be especially true for this year because we haven't had appreciable moisture from rain events since last December. Our soil profile is generally depleted. Where limited irrigation well capacities are insufficient to meet peak water demand of crops, we must rely upon stored soil moisture to help meet these demands. This cache of stored soil moisture is established in the pre-season and early crop season periods. Some useful considerations for pre-plant irrigation decisions follow:

Soil moisture storage capacity

Soil moisture characteristics: A soil's capacity for storing moisture is affected by soil structure and organic matter content, but it is determined primarily by soil texture. Approximate plant available water storage capacities for various soil textures are shown below.

Plant available water storage by soil type



A recommended target of soil moisture storage is approximately 75% of full field capacity. This will allow for room to store water from timely rains. Although the amounts vary from year to year, the long-term average precipitation at Lubbock is 1.1 inches in April and 2.7 inches in May.

If the goal is to apply water to moisten the root zone to some target level (75% field capacity, for instance), it is essential to know how much water the soil will hold at field capacity, and how much water is already in the soil. Estimating soil moisture can be accomplished through direct methods (gravimetric soil moisture determination) or indirect methods. Soil moisture monitoring instruments, including gypsum blocks and tensiometers, provide the means to estimate soil moisture quickly and easily. Alternately, you can estimate a soil's moisture condition by observing its feel and appearance. Use a soil probe, auger, or spade to extract a small soil sample within each foot of root zone depth. Gently squeeze the sample in your hand to determine whether the soil will form a ball or cast, and whether it leaves a film of water and/or soil in your palm. Press a portion of the sample between your thumb and forefinger to observe whether the soil will form a ribbon. Compare your sample with the guidelines indicated below for your particular soil type.

Table 1. How soil feels and looks at various soil moisture levels

Soil moisture level	Fine sand, loamy fine sand	Sandy loam, fine sandy loam	Sandy clay loam, loam, silt loam	Clay loam, clay, silty clay loam
0 - 25 % available soil moisture	Appears dry; will not retain shape when disturbed or squeezed in hand.	Appears dry; may make a cast when squeezed in hand but seldom holds together.	Appears dry. Aggregates crumble with applied pressure.	Appears dry. Soil aggregates separate easily, but clods are hard to crumble with applied pressure.
25 - 50 % available soil moisture	Slightly moist appearance. Soil may stick together in very weak cast or ball.	Slightly moist. Soil forms weak ball or cast under pressure. Slight staining on finger.	Slightly moist. Forms a weak ball with rough surface. No water staining on fingers.	Slightly moist; forms weak ball when squeezed, but no water stains. Clods break with applied pressure.
50 - 75 % available soil moisture	Appears and feels moist. Darkened color. May form weak cast or ball. Leaves wet outline or slight smear on hand.	Appears and feels moist. Color is dark. Forms cast or ball with finger marks. Will leave a smear or stain and leaves wet outline on hand.	Appears and feels moist and pliable. Color is dark. Forms ball and ribbons when squeezed.	Appears moist. Forms smooth ball with defined finger marks; ribbons when squeezed between thumb and forefinger.
75 - 100 % available soil moisture	Appears and feels wet. Color is dark. May form weak cast or ball. Leaves wet outline or smear on hand.	Appears and feels wet. Color is dark. Forms cast or ball. Will smear or stain and leaves wet outline on hand; will make weak ribbon.	Appears and feels wet. Color is dark. Forms ball and ribbons when squeezed. Stains and smears. Leaves wet outline on hand.	Appears and feels wet; may feel sticky. Ribbons easily; smears and leaves wet outline on hand. Forms good ball.

Additional instructions and illustrations are available at:
Estimating Soil Moisture by Appearance and Feel (High Plains Underground Water Conservation District)
Estimating Soil Moisture by Appearance and Feel (Univ. of Nebraska)
Other soil moisture monitoring methods are described at:
Soil Water Measurements: An Aid to Irrigation Water Management (Kansas State University)

Root zone depth: Roots are generally developed early in the season, and will grow in moist (not saturated or extremely dry) soil. Soil compaction, caliche layers, perched water tables, and other impeding conditions will limit the effective rooting depth. Most crops will extract most (70% - 85%) of their water requirement from the top one to two feet of soil, and almost all of their water from the top 3 feet of soil, if water is available. Deep soil moisture is beneficial primarily when the shallow moisture is depleted to a water stress level. Commonly reported effective root zone depths by crop are listed in Table 2.

Table 2. Root zone depths reported for various crops.*

Crop	Approximate Effective Rooting Depth (feet)
Alfalfa	3.3 – 6.6+
Corn	2.6 – 5.6
Cotton	2.6 – 5.6
Peanut	1.6 – 3.3
Sorghum	3.3 – 6.6

* These values represent the majority of feeder roots.

Irrigation system capacity

Well capacity: The rate at which water can be supplied to the irrigation system is often the most important limiting factor to irrigation design and management in the South Plains. While it may be preferable to wait until near planting to begin pre-season irrigation, limited capacity of some systems will mean that more time is needed to provide the desired quantity of water to the root zone. Some useful numbers are shown in Table 3.

Table 3. Conversions of water flow rates to depths over time.

Gallons per minute to acre-inches per day		Gallons per minute per acre to inches per day or inches per week		
GPM	**Ac-in/day**	**GPM/Ac**	**In/Day**	**In/Week**
100	5.3	1	0.053	0.37
200	10.6	2	0.11	0.74
300	15.9	3	0.16	1.11
400	21.2	4	0.21	1.48
500	26.5	5	0.27	1.86
600	31.8	6	0.32	2.23
700	37.1	7	0.37	2.60
800	42.4	8	0.42	2.97

Irrigation equipment: Pressurized irrigation systems including: Low Energy Precision Application (LEPA), Low Elevation Spray Application (LESA) and Subsurface Drip Irrigation (SDI) offer an advantage of controlled irrigation rates within system design capabilities. However, some low-flow designs may offer limited flexibility to accomplish high flow rates for pre-plant irrigation, necessitating longer pre-season irrigation periods, and hence an earlier start to pre-season irrigation. Generally speaking, it is advised to start pre-season irrigation as late as possible to minimize opportunity for evaporation and deep percolation losses prior to planting, and to take full advantage of potential spring rains. How much time is required to apply a given amount?

Example: Given the following conditions, how long will it take to achieve the desired target (75% field capacity) soil moisture?

Estimated Root Zone Depth: 5 feet
Approximate soil water at field capacity: 1.5 inch/foot
Target soil moisture: 75% field capacity
Estimated soil moisture before irrigation: 50%
Irrigation capacity: 3 GPM/Acre (1.11 inches per week, Table 3)
Irrigation Efficiency: 80% (Estimated)

Water to be applied: 5 ft X 1.5 in/ft X (0.75 – 0.50) = 1.88 inches
Adjust for irrigation application efficiency 1.88 / 0.8 = 2.3 inches

Time to apply 2.3 inches: 2.3 inches / 1.11 inches per week = 2.1 weeks
It will take just over 2 weeks to apply 2.3 inches of water at a rate of 3 GPM per acre.

Efficiency issues

Research directed by Jim Bordovsky, Texas Agricultural Experiment Station Irrigation Engineer located at Halfway, indicates that pre-season irrigation losses can be high. Rainfall and irrigation water can be lost through runoff, evaporation, and/or deep percolation. Runoff is reduced with application of furrow dikes, circular row configurations under center pivots, contour tillage, cover crops, and/or other conservation practices as appropriate. LEPA irrigation may pose a significant risk of runoff on sloped fields, especially with tight (clay) soils. Careful management can minimize these losses. Under furrow irrigation, runoff control requires careful attention to water advances and set times.

While some evaporation loss is inevitable, we can minimize these losses by addressing factors that contribute to evaporation. Spray irrigation is more vulnerable to evaporative losses (due to wind exposure and greater wetted surface area) than either LEPA or SDI irrigation, but LESA irrigation is more efficient than high-pressure spray methods. High efficiency management of LESA irrigation includes use of nozzles that deliver large water droplets, relatively slow pivot operation to provide deeper water application per irrigation cycle, and (to the extent feasible) avoiding spray irrigation in high wind conditions. LEPA irrigation applications are much less vulnerable than LESA to wind drift losses and they produce a smaller wetted surface area; hence evaporation losses from LEPA will generally be less than those from spray irrigation. SDI irrigation, with little or no surface wetting, minimizes evaporative losses.

Deep percolation losses are often overlooked, but they can be significant. Water applied in excess of the soil's moisture storage capacity can drain below the crop's effective root zone.   In some cases, periodic deep leaching is desirable to remove accumulated salts from the root zone.   But in most cases, deep percolation losses can have a significant negative impact on overall water use efficiency - even under otherwise efficient irrigation practices such as LEPA and SDI irrigation. Furrow irrigation poses increased deep percolation losses at upper and lower ends of excessively long runs. Surge irrigation can improve irrigation distribution uniformity, and hence reduce deep percolation losses. Coarse soils are particularly vulnerable to deep percolation losses due to their low water holding capacity. Other soils may exhibit preferential flow deep percolation along cracks and in other channels formed under various soil structural and wetting pattern scenarios.

In summary

There are other issues, including fuel costs and commodity values, that influence the decisions of whether, when, and how much to apply pre-season irrigation. With high energy costs, limited irrigation resources and a depleted soil profile, it will be essential to manage irrigation with efficiency in mind this year.

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