Irrigation Strategies with Limited Water Resources

- When well capacity is limited or seasonal water allowances are restrictive, farmers may need to alter their cropping and irrigation strategies in order to remain profitable.
- In some limited water situations, crop growth stage may dictate the most economical time to irrigate.
- Some limited water situations may require a reduction in irrigated acres or crop rotation strategies that spread out irrigation supplies over a longer period of time.

Many farmers in the Great Plains region are challenged with having to grow their crops with limited water resources due to declines in groundwater reserves. In order to maintain economic returns sufficient for sustainability, these farmers may need to alter their cropping and irrigation strategies. Outlined below are three common limited water situations with respect to a 126 acre standard pivot:

Low capacity: Well capacity of 350 gpm or less.

Allocated water: 12 inches average annual allocation or less with a well that has adequate capacity (more than 350 gpm), depending upon the year.

Low capacity plus allocated water: 12 inches average annual allocation or less with a less than 350 gpm well.

Growth Stage Targeted Irrigation

Water stress at the reproductive stages can have the greatest impact on yield potential, yet farmers can impose some water stress during the vegetative stages of corn and soybean without sacrificing yield. Research studies have shown that irrigation can be withheld until approximately 2 weeks prior to tassel for corn and full flowering (R2) or early podding (R3) for soybean without incurring yield penalties.[1,2,3] This type of irrigation strategy will require:

- High water holding capacity soils (deep, medium to fine textured soils).
- The soil water profile must be at or near field capacity at the time of planting or seedling emergence.
- The soil water content must be brought back to normal levels once irrigation has commenced to help avoid yield losses.
- Wells must have an adequate pumping rate that can replenish soil water levels quickly when needed.

This strategy is not recommended for irrigation systems with low capacity wells, coarse textured soils with smaller water holding capacities, or when root restricting layers are present at shallow depths.

Table 1. Irrigation application rate with different well capacities on a 126 acre pivot

Well capacity (gpm)	Application rate (gpm/acre)	Amount applied/day (inches)	Amount applied/week (inches)	Number of days to apply 1 inch
200	1.6	0.08	0.6	11.8
250	2.0	0.11	0.7	9.5
300	2.4	0.13	0.9	7.9
350	2.8	0.15	1.0	6.8
400	3.2	0.17	1.2	5.9
450	3.6	0.19	1.3	5.3
500	4.0	0.21	1.5	4.7
600	4.8	0.25	1.8	3.9
700	5.6	0.30	2.1	3.4
800	6.3	0.34	2.4	3.0
900	7.1	0.38	2.7	2.6
1000	7.9	0.42	3.0	2.4

Table developed by Derrel Martin, University of Nebraska-Lincoln; modified by Chuck Burr, University of Nebraska-Lincoln.

Crop Rotation

Crop rotation is a common strategy for water conservation in limited irrigation systems. When alternating between crops with high and low water needs, farmers can reserve irrigation for the high water needs crop, such as corn and soybean, and conserve water on crops that need less water, such as winter wheat. For example, a farmer with an annual irrigation allowance of 10 inches could use a corn-wheat rotation where the wheat receives 5 inches in one season reserving a total of 15 inches of irrigation for the corn crop the following season.

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Reduce Irrigated Acres

When well capacities are limited, consider cropping practices that will result in fewer acres needing irrigation at any one point during the growing season. This could mean devoting a portion of the field to dryland cropping or splitting the field between crops that have different water timing needs such as corn and wheat. For example, peak water demand for wheat is in May and June while corn and soybean require the most water in July and August.

Use Table 1 to determine if your irrigation system can keep up with crop demands throughout the season. The daily and weekly application rates of the irrigation system can be compared with historical or actual crop water use rates for a particular location to determine when crop water needs will exceed the irrigation capacity. For example, a 350 gpm well on a 126 acre pivot can apply 0.15 inches of water per day and 1.0 inch per week. Crop water use rates may easily exceed this irrigation capacity during the reproductive stages (Table 2). If stored soil moisture is not adequate during this peak water demand period, water stress and yield losses could occur. In a situation such as this, a farmer could choose to reduce the irrigated acres. This 350 gpm well could irrigate 62 acres at an application rate of 0.30 inches per day and more closely meet peak crop demands.

Table 2. Average crop water use by growth stage for 113-day maturity corn grown in South Central Nebraska

Growth stage	Average water use rate (inches/day)	Water use during stage (inches)
Emergence (VE)	0.08	0.8
4-leaf (V4)	0.10	1.8
8-leaf (V8)	0.18	2.9
12-leaf (V12)	0.26	1.8
Early tassel (R1)	0.32	3.8
Silking (R2)	0.32	3.8
Blister kernel (R3)	0.32	1.9
Beginning dent (R4.7)	0.24	3.8
Full dent (R5.5)	0.20	3.8
Maturity (R6)	0.10	1.4

Table modified from Kranz, W.L. et al. 2008. Irrigation management for corn. NebGuide G1850. University of Nebraska-Lincoln Extension.

Genuity® DroughtGard® Hybrids

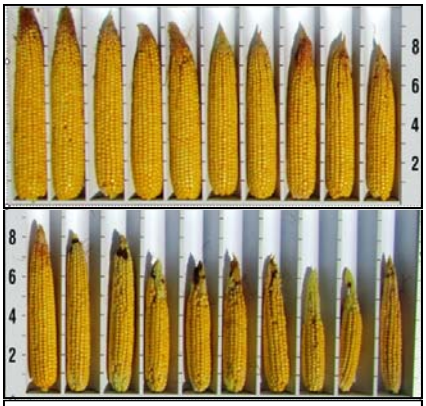

Figure 1. Results from Ground Breakers® 2012 on-farm yield trials. A Genuity® DroughtGard® Hybrids corn product (top) vs. a competitor product (bottom). Trials were conducted under dryland and limited irrigation under severe drought conditions.

DroughtGard Hybrids corn products are part of a systems approach to drought mitigation combining top-yielding germplasm selected for its drought-tolerant characteristics, the inclusion of a drought-tolerant biotechnology trait, and agronomic best management practice recommendations. The systems approach is designed to help farmers manage risk and minimize yield loss when drought stress occurs. Yield trials have demonstrated a 5 bu/acre advantage with DroughtGard Hybrids corn products over other corn products during severe drought conditions and in optimal growing conditions.

Pre-Season Irrigation

A technique used in the southern Great Plains when well capacity is insufficient to fully meet crop requirements during peak water needs is to irrigate before planting a crop. This allows farmers to extend the irrigation season and to provide a relatively full profile before the crop is planted, which helps to buffer the crop from water stress later in the season. Farmers with allocated water should be cautious when applying this technique as pre-season irrigation uses a portion of the allocation to fill the profile, which could have been filled by precipitation. This technique works well on silt loam soils with high water holding capacities. There is little advantage for pre-season irrigation on sandy soils with low water holding capacity.

Sources:
[1] Schneekloth, J.P., Nielsen, D.C., and Schlegel, A. 2012. Irrigation capacity impact on limited irrigation management and cropping systems. Proceedings of the 2012 CPIC. Colby, Kansas, Feb 21-22.
[2] Lamm, F.R. and Abou Kheira, A.A. 2009. Corn irrigation macromanagement at the seasonal boundaries – initiating and terminating the irrigation season. Proceedings of the 2009 CPIC. Colby, Kansas, Feb 24-25.
[3] Torrion, J.A., Setiyono, T.D., Graef, G.L., Cassman, K.G., Irmak, S., and Specht, J.E. 2014. Soybean irrigation management: Agronomic impacts of deferred, deficit, and full-season strategies. Crop Science. vol 54: 1-14.

For additional agronomic information, please contact your local seed representative.