DRY BEAN WATER MANAGEMENT

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The past several years of sustained drought and below average snowpack and summer rains have many in agriculture searching for ways to stretch limited supplies of water. Not only has stream flow decreased, but ground water levels have declined and in many areas pumping restrictions have been imposed. At the same time, competition for water outside of agriculture further increases the demand for limited resources. The combination of drought and the increased demand for water will impose even more challenges for irrigated agriculture. It will require changing current irrigation practices and incorporation of new ideas to better utilize available water supplies as efficiently as possible. This means not only using irrigation water efficiently, but also using precipitation and stored soil water for crop production. Understanding the water needs of a crop will be a key to effective water management.

Water Use

The amount of water needed for irrigation varies by the crop being grown and the climatic conditions from year to year. Given in Table 1 are estimated water use rates for regionally grown crops.

Alfalfa	Corn	Drybean	Spring Grain	Soybean	Sunflower	Winter Grain
31-33	23-26	15-16	18-20	18-20	18-26	18-22

Table 1. Seasonal crop water use (in.) for regionally grown crops.

The depth from which corn gets most of its water is generally considered to be in the top 3 to 4 ft of the soil profile. Corn uses approximately 24 inches of water during the growing season and is often considered a crop that uses a large amount of water. Yet as we look closer, some of the crops we thought used less water, for example sunflowers and winter wheat, we find can use as much water as corn. However in the case of sunflowers and winter wheat, these crops can extract more water from the profile than some other crops without adversely impacting yield potential. Sunflowers also have the ability to effectively extract water to depths of up to eight feet. In this case sunflowers may be viewed as a "drought tolerant" crop when in fact the crop has actually extracted more water from the soil and extracted water from deeper in the soil profile. Anyone growing sunflowers knows that following this crop the soil can be left in a very dry condition the following spring.

Dry beans use approximately 16 inches of water during the growing season, which is approximately 8 inches less than what corn needs. This makes dry beans a good crop to grow if irrigation water is limited or if used as part of a crop rotation system to reduce overall irrigation needs. Dry beans are a shallow rooted crop with the majority of roots found in the top 18 in. of the soil profile. Roots can grow deeper into the soil profile to get water but this usually occurs late in the growing season as the plants begin to mature.

Water Management

The question of when is the best time to apply water to a crop often comes up when water supplies are limited. Some producers feel that stressing dry beans early in the growing season has little impact on yield and may even improve yield by forcing the roots to grow deeper into the soil profile. A similar question asked is whether stopping irrigation late in the season reduces yield?

For dry beans, early and late season water stress experiments have been conducted at the Panhandle Research and Extension Center in Scottsbluff, NE. The results of those experiments are given below.

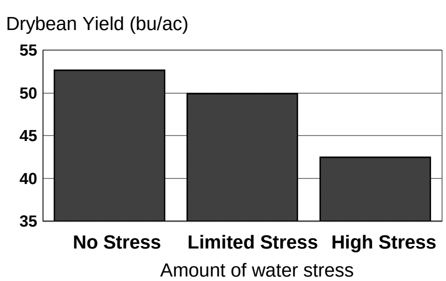

Figure 1a. Effect of early season water stress on dry bean yield using sprinkler irrigation.

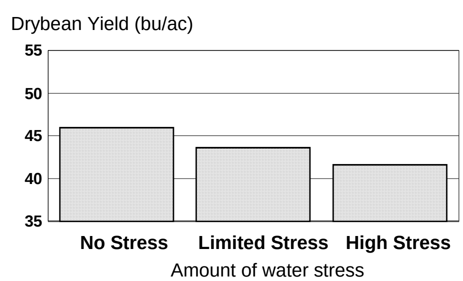

Figure 1b. Effect of early season water stress on dry bean yield using furrow irrigation.

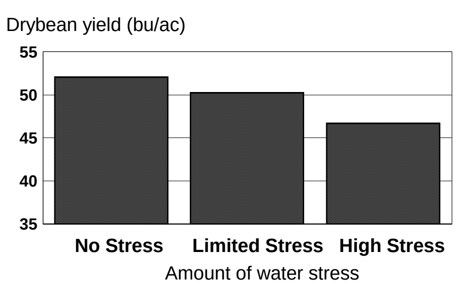

Figure 2a. Effect of late season water stress on dry bean yield using sprinkler irrigation.

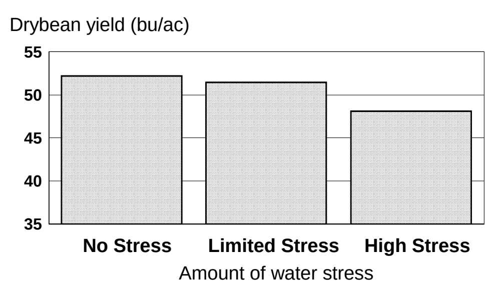

Figure 2b. Effect of late season water stress on dry bean yield using furrow irrigation

Figures 1a and 1b, show the results of dry bean yield when water is limited during early season growth for sprinkler and furrow irrigation systems, respectively. The no stress treatment had irrigation starting approximately the last week in June to the first week in July. For the limited and high stress treatments, the initial irrigation was delayed for one week and two weeks, respectively. When sprinkler irrigation was used, yield tended to decline more as water stress increased compared to the furrow irrigation system. This is especially true for the high stress treatment under sprinkler. Yield loss was greater when water was withheld for two weeks because of the inability of the sprinkler system to replace soil water and meet the future water demand of the crop. The furrow irrigation system in these experiments refilled the soil profile and thus was able to provide adequate and immediate water for future water use. Under grower conditions if stress is allowed, furrow irrigation will likely require an extended period of time to irrigate the complete field thus causing further yield reduction similar to the sprinkler trials. Because the sprinkler and furrow experiments were conducted at different locations, comparisons between the two irrigation systems should not be made.

In figures 2a and 2b, the results of shutting off water late in the season are also shown for both sprinkler and furrow irrigation systems. The no stress treatment had irrigations throughout the growing season. Starting August 10, the limited stress treatment received every other irrigation that was scheduled for the no stress treatment while the high stress treatment received no further irrigations. Similar to the early season water stress results, dry beans irrigated with a sprinkler system showed a slightly steeper decline in yield as water stressed increased. The decline in yield is again likely related to the inability of the sprinkler irrigation system to supply water in excess to the requirements of the crop. Once irrigation was reduced or stopped less water was available in the soil profile to meet crop demands. Once again, the sprinkler and furrow experiments were conducted at different locations and comparisons cannot be made between the two irrigation systems.

When comparing the early and late season experiments, there is a steeper decline in dry bean yield when water stress occurs at the beginning of the season as compared to water stress late in the season. These results are probably not uncommon and could be expected for most crops. Early in the season plant root development is limited and therefore water stress can occur rapidly. The lack of water during initial stages of plant growth likely impacts the majority of the root system. Late in the growing season, roots are more developed and reach further into the soil profile. Therefore water stress late in the season will first impact roots high in the soil profile while those deep in the profile may continue to extract some water to meet the needs of the crop. Finally, because the plant is nearing maturity, the need for water is declining on a daily basis. As a result, the root system can more easily keep up with the needs of the plant as water in the profile slowly moves to replace the water used by the crop.

These results show for western Nebraska that if water is limited and the irrigator has the ability to choose when water supplies can be used on their bean crop, the choice should be to use water early in the season to maintain plant growth and encourage root development deep into the soil profile. Reducing irrigation late in the season can result in water stress which will likely reduce yield. However, compared to water stress early in the season, late season stress can have less of an impact on total production.