

IRRIGATION MANAGEMENT IN SMALL GRAINS

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Regardless of whether or not we are in a drought situation, proper irrigation management will allow our small grains to develop in a less stressful condition resulting in more consistent yields and possibly better quality. Irrigation management begins by understanding how moisture stress will impact the crop at various growth stages and determining what growth stage to shut the water off.

Stressing the crop from emergence through tillering is not recommended. Although total yield loss may be minimal up through early tillering, between tillering and stem elongation the grain's yield potential is being produced. Stress during this phase will limit the total number of heads produces.

Stressing the crop from the jointing through heading phase is not recommended since we want the head to emerge properly and uniformly. As stated above, the maximum yield potential has been determined prior to this point (see figure 1) and nothing can be done to add to the grain's yield, however additional stress can result in a yield reduction.

Finally, stressing the crop from flowering to grain fill is not recommended since we want to ensure that the kernels get properly fertilized and that the grain bulks properly. But after grain fill finishes and starts to mature, water use demand decreases rapidly.



Figure 1. At early jointing you can peel back the stem and expose the immature seed head and under a microscope you can count the number of seeds per head. This is the small grains maximum potential yield.

Figure 2 shows the average daily evapotranspiration rate in the Mini-Cassia area, as well as the average root depth for small grains. From about the 2-4 leaf stage water use demand is low and has a shallow root system. As the crop grows, the water use demand increases, as well as the root depth. The advantage of the low water use demand early in the season is that it allows the producer to fill the soil profile with water early. This is important because once the crop reaches peak water use demand, the producer will not be able to apply water fast enough to maintain proper soil moisture, and the deep soil moisture will help offset the water deficit, see figure 3.

However, water use demand is only at its peak up to the soft dough stage. At this growth stage water use demand decreases rapidly and additional irrigation will refill the deep soil moisture quickly, see figure 3. From all the research that has been conduct, cutting water off at the soft dough stage, with a full soil-water profile, is the best plan. Additional water after this stage doesn't appear to provide any economic benefit, see Figure 4 and 5.

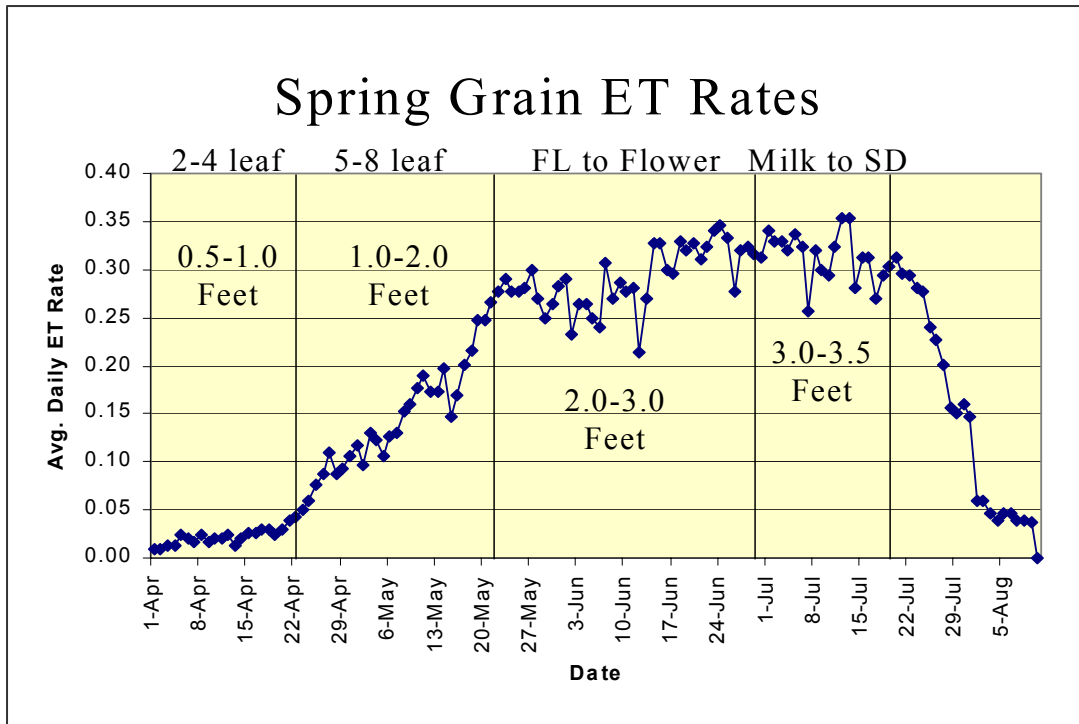


Figure 2. Average daily evapotranspiration rate and small grain root depth for the Mini-Cassia area. Water use demand is low at the beginning of the season, peaks from flag leaf through grain fill, and declines rapidly after soft dough.

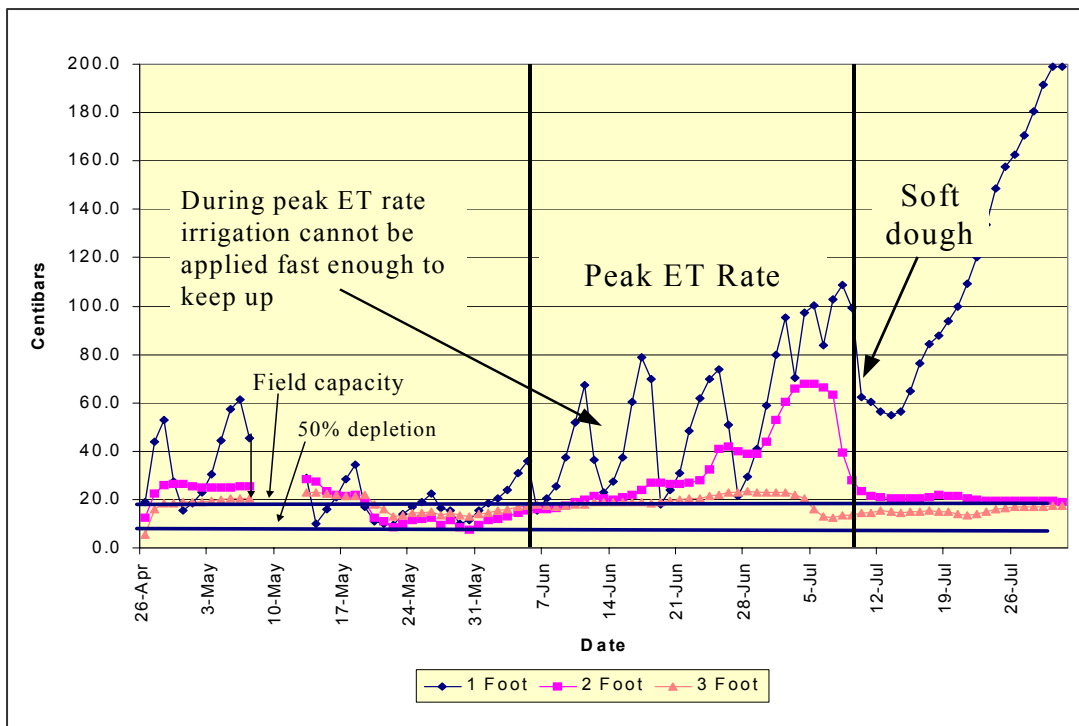


Figure 3. Water use in a winter wheat crop on sandy soil. Low water use demand early in the season allows time to fill soil profile with water, which is needed during peak water use. After soft dough water use demand decreases.

Now there are some exceptions. If you are on sandy or shallow soil then an additional or reduced irrigation may be necessary due to the soils low water holding capacity. Also, if your grain is on a pivot, then you may need one additional revolution if it isn't applying enough water to push the moisture down to the 3rd foot of the soil profile.

The next question is, what is the soft dough stage? This is always up for debate, but this is what I look for when giving a recommendation.

If the grain is bulked up, doughy, and firm then you know you're in the ballpark. After that I squeeze the grain. If the contents look like wet dough but firm, even with a little moisture coming out, then I consider that early-soft dough.

Next, I determine where the irrigation is in the set. If there are still several days left in the rotation then the grain may be at, or mature past, the soft dough stage by the time the irrigation needs to start over. Before starting the irrigation over I check the soil moisture. If the crop didn't use much moisture over the last several days then you're probably done. Remember, the roots should be over three foot deep (if your soil depth reaches that far) and will utilize that moisture. If the soil is dry then an additional irrigation over the first 2 or 3 sets, for about 8 to 12 hours per set, may be justified.

Finally, look at the lower nodes of the plant. If they easily break in half and are crisp, then that is an indication that additional water will be of little benefit. When they break that easily the nodes are closing off and will not be able to extract as much soil moisture.

So if you're at the early-soft dough and you have a few days left in the set, finish the irrigation out and check the grain again. If there is good moisture and nodes are closed off then probably your done.

If you still have a few days left in your rotation but the grain is well into the soft dough stage. Then check to see how the soil moisture is in the remaining sets. If you have some moisture down deep then maybe all you need to do is reduce the length of your remaining sets.

The question that remains is: does cutting the water off at the soft dough stage, with a full soil moisture profile, have a negative impact on yield? Actually, it's quite the opposite. Shutting the water off at the soft dough stage, with a full soil moisture profile, will probably result in the highest and most consistent yield. See figures 4 and 5. Additional water past the soft dough stage generally is wasted. As the crop matures water use decreases and the additional water remains in the soil. In addition, the chance of the grain developing black tip also increases with additional water. The bottom line is that grain doesn't benefit from over irrigation.

In conclusion, it is always to your advantage to put the water down deep at the beginning of the season and keep it off at the end. This will result in more efficient irrigation, less black tip, and possibly better economic return, especially if the pumping costs are high.

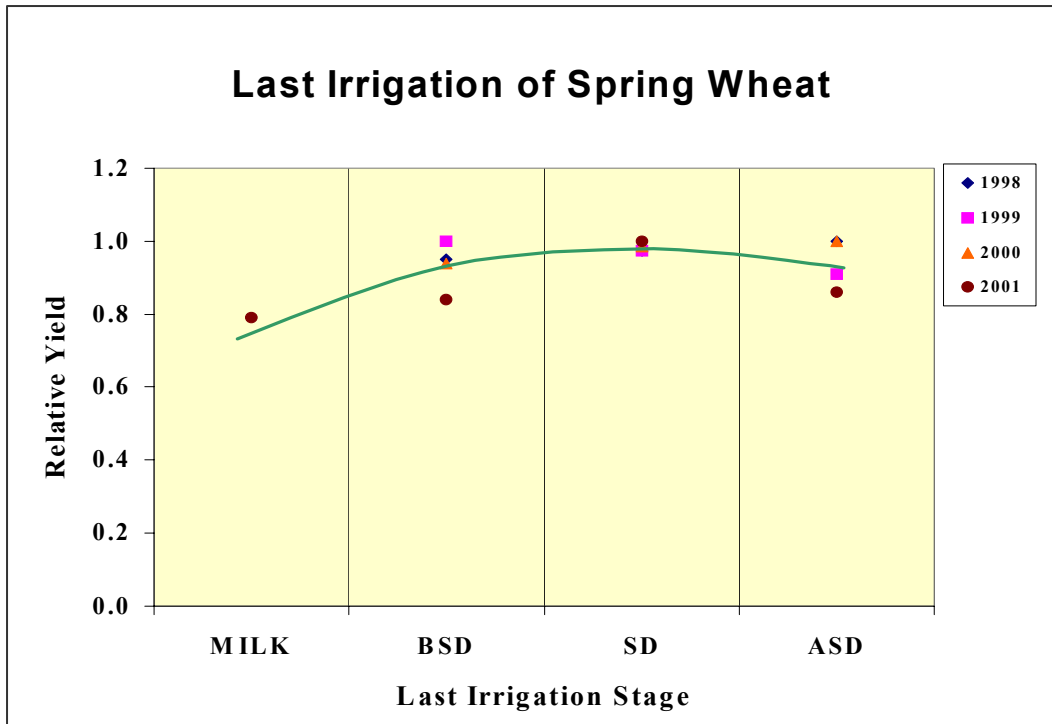


Figure 4. Relative wheat yield at various growth stages that received the last irrigation. Cutting water off at the soft dough stage resulted in the highest and most consistent yield over a four-year period.

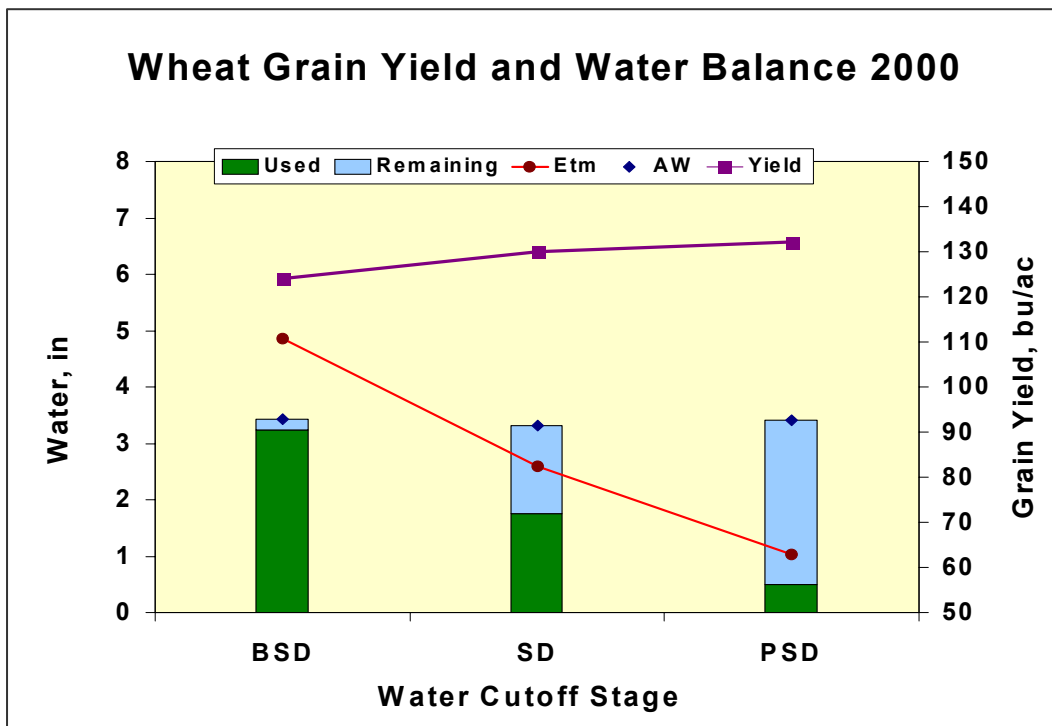


Figure 5. Yield and remaining soil moisture for various growth stages that received the last irrigation. Yield did not differ when water was last applied at either soft dough or post soft dough, but more water remained in soil when last irrigation was applied post soft dough.