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# Small Grain Irrigation

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**Water use and requirement**

Wheat and barley use about 2 ft. of water in Arizona, but 3-3.5 ft. of applied water is often required with surface flood irrigation due to inefficiencies in the irrigation system. Less irrigation water is required with more efficient irrigation systems such as sprinkler or drip. An example schedule for Maricopa is presented in Table 1. For an explanation of small grain growth stages and heat units to attain these stages see Ottman (2004).

**Seasonal water use**

Water use in small grains is negligible during early development, increases rapidly during jointing, peaks during grain fill, and falls steeply during senescence as the crop turns color. Water use is most affected by developmental stage before the crop fully covers the soil surface and after the crop turns color. Otherwise, water use increases as the season progresses due to increased solar radiation and temperature.

**Susceptibility to water stress at various stage**

Water stress at any stage can reduce yields of small grains. However, small grains are most susceptible to water stress during jointing, least susceptible during grain fill, and intermediate in susceptibility during tillering.

**First Irrigation**

The first post-emergence irrigation for wheat and barley is usually needed by about the 5-leaf stage. Applying the first irrigation earlier may temporarily increase crop growth but not increase grain yield, or may actually reduce crop growth through waterlogging or cooling of the soil. The first irrigation may be applied early to help in the germination of the seed if the soil crusts or to prevent seedling desiccation in cracking soils. The first irrigation may also be applied early if the crop has a critical need for nitrogen fertilizer. Plant wilting is usually a sign that the first irrigation is needed or should have been applied some time earlier.

**Last Irrigation**

Applying an unnecessary irrigation at the end of the season wastes water and can cause lodging. Conversely, water stress at the end of the season may reduce kernel weight, test weight, and yield. On a sandy loam soil, the last irrigation is needed at soft dough. About 3-4 inches of water is needed to carry the crop from soft dough to maturity. On sandier soils, the last irrigation may be needed between soft dough and hard dough, and on heavier soils the last irrigation may be applied before soft dough.

Table 1. Example irrigation schedule for small grains at Maricopa

| Stage | Irrigation Date |
|---|---|
| Planting | Dec 10 |
| 5-leaf | Feb 04 |
| 2 nodes | Feb 27 |
| Pre-boot | Mar 16 |
| Heading to flowering | Mar 30 |
| Milk | Apr 11 |
| Soft dough | Apr 22 |

Obviously, the timing of the last irrigation depends on soil type, the irrigation system, the growth stage of the crop, expected weather conditions, and other factors. Nevertheless, no irrigation water is needed once the heads have completely turned color from green to tan since the crop is mature at this point and the kernels cease to accumulate dry weight.

**Soil water balance method**

Small grains should generally be irrigated when 50% of the available water is depleted. Irrigations can be scheduled using set calendar dates or days between irrigations based on grower experience, methods that directly measure soil moisture or crop stress, or the soil water balance method. The soil water balance method of irrigation scheduling treats soil water as a bank from which water is withdrawn by the crop and water is deposited by irrigation when withdrawals reach a critical level. The critical level is referred to as a maximum allowable depletion, and is the product of acceptable depletion fraction. Daily crop water use can be estimated by multiplying a crop coefficient (Kc) specific for a crop and growth stage by evapotranspiration for a grass reference crop (ETo) provided by the Arizona Meteorological Network, AZMET (http://ag.arizona.edu/azmet).

The computer software program, Arizona Irrigation Scheduling System, AZSCHED (http://cals.arizona.edu/crops/irrigation/azsched/azsched.htm) uses the soil water balance approach to schedule irrigations and automatically calculates water use from data provided by the automated weather stations.

***Also see:*** *Ottman, M. 2004. Irrigation of Small Grains in Arizona*
*http://cals.arizona.edu/pubs/crops/az1345.pdf*
*Ottman, M. 2004. Small Grain Growth and Development*
*http://cals.arizona.edu/pubs/crops/az1347.pdf*



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