IRRIGATION OF SPRING WHEAT

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Spring wheat can be grown with one-third less water if University of Idaho recommendations for irrigation are followed. G. M. McMaster, left, and an assistant check the quality of wheat that drew 10.1 inches of moisture from the root zone, comparing this with wheat drawing 15.1 inches of moisture. The wheat produced under the lower moisture level made greater yields of higher protein grain.

Moisture Requirements

The number of irrigations required by a spring wheat crop depends on several factors—climatic conditions, location and the amount of water in the soil, and irrigation efficiency. Although soil texture and water-holding capacity greatly influence the number of irrigations required, their effect on the amount of water used by the plant is of minor importance.

Carryover moisture from winter precipitation is the main source of water to start spring wheat. The seed should be planted as soon as soil and weather conditions will permit. At this time the surface few inches may appear quite dry but the soil below the 3-inch level will be near field capacity if the winter precipitation has been normal. Care should be taken to place the seed to the soil depth where moisture is adequate for germination.

Moisture levels from planting to heading have a great effect on yield and quality of spring wheat. A medium soil-moisture level during this period promotes better tillering and consequently a higher yield than a high-moisture level. Table 1 shows the effects of two soil-moisture levels from planting to heading on spring wheat grown at Twin Falls. The soil-moisture level shown in the table represents the minimum percent of available soil moisture in the root zone. The maximum amount was field capacity just following an irrigation. Sedimentation is a measure of the gluten quality of the flour. A high sedimentation value is desirable in hard red wheats while a low sedimentation is desirable in the soft white.

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Recommendations

Until the wheat is 6 inches high, check the soil approximately 4 inches below the surface for its moisture content. When the plants become taller, check at the 9-inch level. In soils with deeper root zones, check the moisture content at approximately one-third of the root zone depth.

1. Do not irrigate until the available soil moisture in the root zone falls to 45% before heading.
2. Set up the irrigation schedule to provide high soil moisture levels at heading. Water use requirements are at a peak at this time.
3. After heading, allow the available soil-moisture level to fall to 20% before applying the subsequent irrigation.
4. If good moisture is available in a medium-textured soil (high water-holding capacity), it is not necessary to irrigate after the soft dough stage.
5. Three irrigations have produced the maximum yield on medium-textured soil with normal spring rains near Twin Falls.
6. If you are interested in the premium for low protein soft white wheat, irrigate when the available moisture reaches 65% before heading, but expect less tillering and decrease in yield.

Table 1. Spring Wheat Yield and Quality Resulting From Selected Irrigation Treatments Up To Heading, Twin Falls, 1964 and 1965.†

Class	Soil Moisture before heading	Yield B/A	Protein %	Tillering head/ft²	Sedimentation
Soft White	65%	60.0	11.1	38.0	22
	45%	68.5	11.8	42.0	23
Hard red	65%	56.3	13.2	41.2	49
	45%	62.8	14.2	47.7	51

† Average of all moisture levels used after heading.

Yield, protein content and tillering were all greater under the medium soil-moisture levels (45% minimum) than under the high (65% minimum). This is desirable for hard red wheat; however, the lower protein content is better in the soft white. *If the decision is made to irrigate soft white wheat for the lowest protein content, a reduction in yield will probably result.* Sedimentation was not greatly affected by soil moisture.

Nitrogen application rates can be used in combination with irrigation management to control wheat yield and quality. *More nitrogen has been found necessary when wheat is over-irrigated early in the growing season.* Figure 1 shows the effect of nitrogen applied at four levels to grain irrigated on two different schedules at Twin Falls. This figure shows the savings in nitrogen when the wheat was not over-irrigated early in growing season.

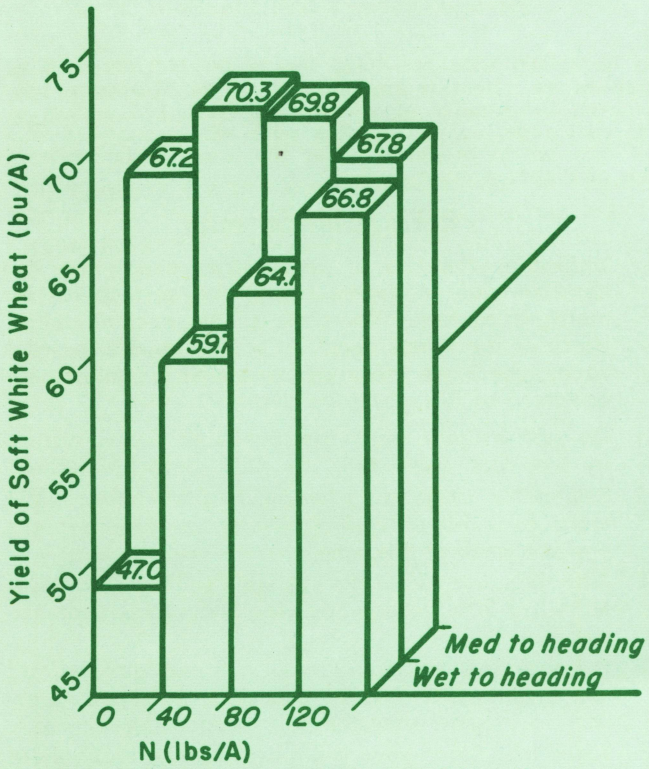

Figure 1. Soil moisture and nitrogen interaction.

Irrigation From Planting to Heading

During the early part of the growing season the plant roots are located in the upper few inches of the soil and the *soil moisture should be checked at about the 4-inch depth* to determine the need for irrigation. *After tillering, the roots have penetrated deeper and may extract water from as deep as 3 feet.* The majority of the roots, however, are still located in the upper 18 inches of soil *so the soil moisture should be checked at about 9 inches below the surface.*

Spring precipitation is an important factor in determining when the first irrigation should be applied. Assuming a medium-textured soil and normal spring rains, there should be sufficient moisture to carry the wheat crop to the boot stage. If spring rains are light or your soil has a low water-holding capacity, the crop must be irrigated sooner. Check your soil periodically to determine the amount of water in it. Care should be taken not to over-irrigate early in the season. Excess water leaves the soil slowly and tillering will be limited. Over-irrigation also wastes fertilizer. *The first irrigation should wet the root zone to a depth of 12 inches.*

Irrigation After Heading

Soil moisture after heading has less effect on yield and protein content than early in the growing season. Table 2 shows the effects of moisture levels from heading until maturity on spring wheat grown at Twin Falls. A higher yield and the highest protein content occurred with the lowest soil-moisture level. *For maximum yield, wheat should not be over-irrigated after heading.* Check the soil moisture at the 9-inch depth. When available soil moisture drops to 20 percent, irrigate. The wetted front should reach the bottom of an 18-inch root zone with these irrigation.

Table 2. Spring Wheat Yield and Quality Resulting From Selected Irrigation Treatments After Heading, Twin Falls, 1964 and 1965.

Class	Soil-moisture level after heading	Yield B/A	Protein %	Sedimentation
Soft white	65%	62.2	11.1	20
	45%	63.7	11.4	21
	20%	66.5	11.9	25
Hard red	65%	57.5	13.5	50
	45%	60.5	13.6	49
	20%	60.5	14.1	50

The last irrigation should not be applied too close to harvest. The water-use rate is low. Late irrigation is not necessary. The date of last irrigation is not critical as long as there is sufficient water in the soil to prevent shriveling of the kernel. On most soils, if the root zone is nearly full of water at soft dough, no more irrigations are needed. *The crop will be ready for harvest in about 20 days and shriveling will not occur.* On very light soils, however, the last irrigation should probably be applied after the soft-dough stage. This can be determined by the appearance of the kernel. It should be fully sized and give a thin paste when squeezed.

Moisture and Varieties

Generally the varieties of spring wheat react similarly to soil-moisture levels. *Medium to low moisture levels will result in higher yields, higher protein contents and slightly higher sedimentation values.* These are desirable traits for hard red wheat. Soft white wheat, however, doesn't require high protein and sedimentation. If it is necessary to obtain a lower protein content in soft white wheat, irrigate more frequently. This will, however, reduce yield and it is doubtful that this practice is economically feasible.

The yield, protein and sedimentation values

shown in Tables 1 and 2 for soft white and hard red wheats are the average of two varieties in each class for 2 years. The soft white wheats were Idaed 59 (1964) and Lemhi (1965). The hard reds were Thatcher (1964) and C. I. 13744 (1965).

Consumptive Use Rates

The estimated water use by spring wheat grown at Twin Falls is 16.2 inches. This estimate is based upon average climatic conditions in the area. Actual measurements taken at Twin Falls show different consumptive use rates for different soil-moisture levels. Consumptive use curves are shown in Figure 2 for two different soil-moisture levels maintained in the root zone.

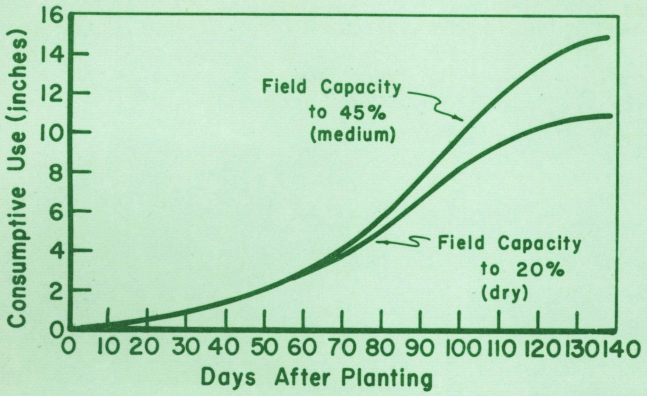

Figure 2. Measured consumptive use of spring wheat grown under two soil-moisture levels at Twin Falls, Idaho, 1963 and 1964.

The total *amount of water used from the root zone of spring wheat grown at Twin Falls was found to be 15.1 and 10.1 inches.* The actual amount of water applied to the field will be considerably greater than this, however, and will depend upon several factors. Irrigation efficiency or water management is probably most important. Good water management requires filling the root zone reservoir with only a small amount of waste. This requires that you know the water holding capability of your soil and the characteristics of your individual irrigation system. With surface irrigation, twice as much water is usually applied as the plant actually uses. With sprinkler irrigation, slightly less excess water is applied.

The most water was used by spring wheat when the available soil-moisture level was never allowed to fall below 45 percent in the root zone. The least water was used when the wheat crop was permitted to deplete available soil moisture to 20 percent before irrigation.

Two typical irrigation schedules and soil-moisture depletion curves are shown in Figure 3. When applied to a medium textured soil of high water-holding capacity, frequent irrigations as shown in the lower curve will result in the higher water-use curve of Figure 2. When fewer irrigations are

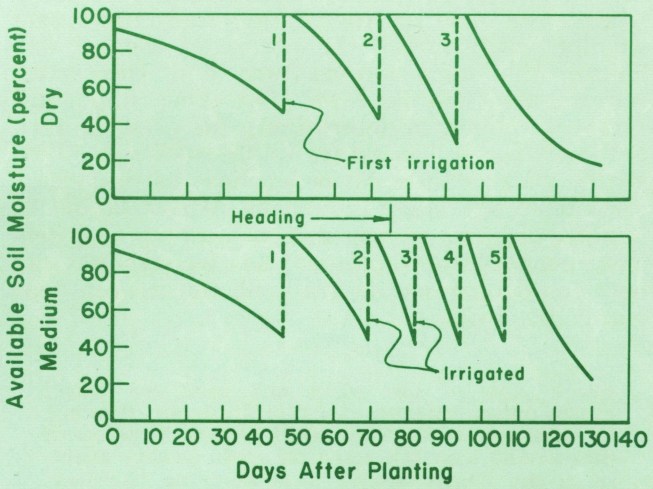

Figure 3. Typical soil-moisture depletion curves for spring wheat grown under two soil-moisture levels on Portneuf Silt Loam soil.

spaced throughout the growing season as in upper curve, the soil-moisture level will be lower at the time of irrigation and the lower water-use curve of Figure 2 will result.

Stages of wheat development and corresponding water use are shown in Figure 4. Peak water use occurs between heading and the soft-dough stage. Irrigation water should be applied just prior to heading to aid pollination and prepare for the following high water use period. Planning for this irrigation must begin early in the season to allow adequate time after the preceding irrigation.

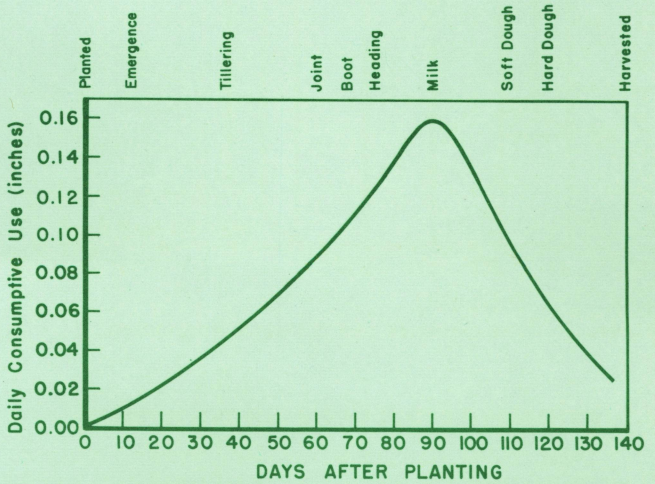

Figure 4. Consumptive water use through the growing season is charted by this figure. This pattern of water use can serve as a guide to planning irrigation.

Water requirements are low from planting to the boot stage. Intervals between irrigations should be longer during this time; in fact, *excessive irrigation during this period has been shown to decrease tillering and consequently reduce yield.*

The stage of plant growth (i.e. tillering or heading) and climatic conditions are good

indicators of the water requirements of spring wheat. For instance, the heading and milk stages usually occur during the period of longest day length and high temperature and the water requirement will be high. The most important factor, however, in determining the need for irrigation is the soil moisture in the root zone. Irrigation water should not be applied just because a certain growth stage is reached. *Water should be applied because certain soil moisture is reached.* Your county extension agent has a chart that can help you determine the available moisture in your particular soil.

Check plots of soft white and hard red wheat grown under differing moisture levels are threshed in small lots at the Twin Falls Branch Experiment Station and kept separated for grain quality analysis at the Wheat Quality Laboratory at Aberdeen.

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