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Irrigation of winter wheat in Colorado

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Quick Facts

Water should be applied in amounts that will promote a deep, extensive root system.

Avoid irrigations during the early spring vegetative growth.

The most critical growth stages for irrigations are during the fall period when the soil profile should be filled to a depth of 4 to 6 feet and then during the boot to heading stage.

Monitoring soil moisture is highly recommended to aid in determining correct irrigation scheduling.

Growing irrigated winter wheat is more successful when used in a crop rotation rather than in continuous cropping.

Winter wheat is predominantly a dryland crop in Colorado, but the importance of winter wheat as an irrigated crop has increased as farmers become concerned about reducing the costs of pumping water for production of other crops. While the irrigation of winter wheat can produce high yields, some irrigation management techniques are important in producing consistently high yields with minimum input costs. Winter wheat will respond to additional water in Colorado (Table 1).

Table 1: Average grain yields of winter wheat variety trials under irrigated and dryland conditions in eastern Colorado during 1984 and 1985.

	Dryland		Irrigated	
Year	Yield Bu/A	# of locations	Yield Bu/A	# of locations
1984	45.8	17	87.2	7
1985	52.8	19	91.4	6

The entries in these trials are similar but not the same.

The Wheat Plant

Wheat grows best under dryland conditions where stored water promotes a deep, extensive root system. Irrigation practices should be conducted to provide soil water storage promoting the development of this type of root system. The amount and timing of irrigation on wheat and water storage will depend on the type of soil, i.e., sandy vs. silt or clay loams (Table 2).

Table 2: Available water holding capacity of soils of different textures.

Soil texture	Inches of water/foot of depth
Coarse sand	0.75
Find sand	1.00
Fine sandy loam	1.50
Silt loam	2.00
Clay loam	2.20
Heavy clay	2.00

Water Use

During fall growth, moisture is removed primarily from the top foot of soil. The wheat plant will extract most of its moisture from the 0 to 4 foot depth in the spring. As the plant develops and moisture needs increase, the root system will continue to develop and compete in zones where soil moisture is present. If needed, the plant will use moisture from the 4 to 6 foot zone to meet its water needs. Total water use by winter wheat will vary but under optimum soil moisture conditions, total seasonal use may reach 23 to 24 inches (Figure 1).

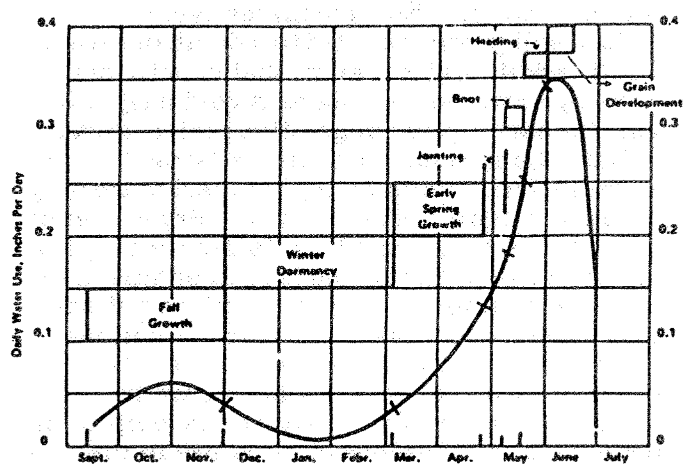

Figure 1: Characteristic water use of winter wheat.

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Wheat crops need about 3 to 5 inches of water from seeding until April 1. Wheat will produce from 2 to 6 bushels for each additional inch of water thereafter depending on evapotransporation during the vegetative, heading and grain-filling period.

Critical Timing of Irrigations

There are two growth stages where irrigations will promote the greatest increase in yields. The first critical period is the fall vegetative stage where a single irrigation should fill the soil profile to a depth of 4 to 6 feet on flood or furrow irrigated fields. With sprinkler irrigation, filling the profile becomes more difficult, since the amount of water necessary cannot be applied in a single application. The center pivot should be adjusted to turn very slowly and apply as much water as possible on a single pass. Care must be taken, however, to prevent runoff and erosion.

A fall application of 4 inches on sandy soil or 8 inches on clay loam soil should be adequate to fill the soil profile about 4 feet deep. This level of irrigation will allow the soil to store winter moisture, if available.

After spring growth begins, irrigation amounts are based on the amount of water used over the winter. In a normal year, water should be applied to loamy soils in the late boot stage. Earlier irrigation will produce rank growth and may cause lodging.

Obviously, runoff and erosion problems must be considered when using a high application rate. Several light sprinkler applications will only keep the water near the surface causing high evaporation losses and reduced infiltration rates. High amounts of crop residue on or mixed in the surface soil is helpful when applying large amounts of water with a sprinkler system.

If the soil profile is filled to a depth of 6 feet in the fall, additional water probably will not be necessary until the boot stage. Avoid irrigations during the early spring vegetative period, because they have the tendency to promote "straw" rather than grain. Irrigations during this period are only necessary if there has been a warm, dry winter or in case of very coarse sandy soils. Monitoring soil moisture early in March and then later during the boot stage is important in determining if additional water is necessary. To monitor soil moisture, a moisture probe (steel rod with ball bearing tip), a soil tube that will extract a core from the soil profile, or simply a shovel is helpful in determining the presence of moisture in the root zone. The need for early spring irrigations is more likely with sandy soils, because of the low water holding capacity. For more information in estimating soil moisture, see Service in Action 4.700, "Estimating Soil Moisture for Irrigation."

Adequate soil moisture from the boot stage through the bloom stage will increase grain yield and test weight. This stage occurs during the highest precipitation month (May) of the year. Late irrigation near the dough stage may be beneficial, but the result may be a higher incidence of lodging.

Fertilizer Management

Nitrogen requirements will depend heavily on the cropping system, e.g., wheat after fallow, wheat after corn or continuous wheat. Soils in eastern Colorado testing 25 to 30 ppm NO_3-N in the soil with 1.1 to 1.5 percent organic matter require 25 pounds of additional nitrogen per acre to provide a nutrient level capable of 100 bushels per acre (Table 3). On the other hand, soils with 0 to 6 ppm NO_3-N and less than 0.5 percent organic matter will require up to 130 pounds of nitrogen per acre for the 100 bushels per acre yield level. Soil testing is highly recommended and is the best way to accurately determine fertilizer requirements.

Table 3: Nitrogen recommendations for wheat with 100 bu/a yield goal.

NO_3-N soil test	Soil organic matter—%				
	0-0.5	0.6-1.0	1.1-1.5	1.6-2.0	2.0
ppm	Fertilizer N-lb/a				
0-6	130	120	105	90	75
7-12	110	100	85	70	55
13-18	90	80	65	50	35
19-24	70	60	45	30	20
25-30	50	40	25	0	0
31-36	30	20	0	0	0
36	0	0	0	0	0

Adjust N recommendation for yield goal different from 100 bu: add 15 lb N for each 10 bu above 100 bu; subtract 10 lb N for each 10 bu below 100 bu.

Special Note: Increase above recommendations by 40 lb N in the following counties: Alamosa, Conejos, Costilla, Rio Grande and Saguache.

With furrow-irrigated fields, it is desirable to apply nitrogen during or after pre-plant irrigation to avoid leaching losses. For sprinkler-irrigated fields, some of the nitrogen can be applied through center pivot irrigation systems. Nitrogen, phosphorus and other fertilizer nutrients should be applied on the basis of the fertilizer test.

Continuous Cropping vs. Rotations

Continuous irrigated wheat in a rotation is not a successful practice because of the consistent yield decline over a period of years. This decline occurs partly because of the difficulty in deep water penetration from center pivot sprinklers. Nutrient deficiencies, disease problems and insect or weed pressures also become significant problems in continuous irrigated wheat. It is recommended that irrigated wheat be incorporated into a rotation where possible. Wheat fits quite well in rotations because peak irrigation times for wheat do not coincide with peak demand times for other crops, e.g., corn, beans, etc.

Varieties

The results from irrigated variety trials located throughout Colorado should be used to aid in selecting a variety for a particular location. For irrigated fields, the semidwarf varieties have had consistently high yields and are preferred to avoid lodging.