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Philip Grabouski
University of Nebraska - Lincoln

Walter Trimmer
University of Nebraska - Lincoln

Louis Daigger
University of Nebraska - Lincoln

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NebGuide

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G 78-398

Irrigated Small Grain Production

Phil Grabouski, District Extension Agronomist; Walter Trimmer, District Extension Irrigationist, and Louis Daigger, District Extension Soils Specialist

Excellent management practices for irrigated small grains are necessary to obtain high yields. What varieties should I use? How should the seedbed be prepared? What row spacing is best? What plant nutrients are needed? How much fertilizer should I use? When should I apply the fertilizer? What is the water intake rate of my soil? How much will it hold? When is the best time to irrigate? These are some of the questions in the mind of the irrigated small grain producer.

Varieties and Stand Establishment of Winter Wheat

Yields are directly related to the number of heads per unit area. Use varieties recommended for your area. The variety Centurk is known for its tillering and high yield potential. Newer, shorter-strawed varieties are also available. Outstate Testing Circulars reporting fall and spring grain yield results are obtainable from county Extension offices.

Prepare a seedbed firm enough to provide good seed-soil contact and have sufficient moisture for quick germination and seedling establishment.

Early planting (late August in western Nebraska) may encourage diseases such as crown and root rots. Downy brome seedlings are also a problem in early-seeded fallow and continuous wheat. In areas where Hessian fly may be a problem, growers should not seed until after the fly free date for their area.

The seeding rate will vary in the area of the state where the crop is to be grown. Increase seeding rates by 50% when livestock grazing is planned. Row spacing research shows little influence on grain yields of irrigated small grains. The amount of soil roughness desired, depth to moisture, amount of residue and initial cost and maintenance will be factors to consider in determining the proper drill spacing. Furrow drills with large disks have worked satisfactorily when seeding in mulched soils. Wind erosion of valuable top soil must be kept to a minimum.

Fertilizer

Apply only fertilizer nutrients that are needed. Soil test results from the 0-8 inch (20.32 centimeters) plow layer will be a guide in using nutrients other than nitrogen. Nitrogen needs can best be determined by sampling to a depth of 3 to 4 feet (91.44 to 121 cm).

Phosphorus fertilizer has increased small grain yields on many Nebraska soils. Potassium response has not occurred in research trials conducted in Nebraska. Zinc has not increased yields of small grains - even where the soil test showed a low zinc content.

Since nitrogen can be applied any time up to flowering stage, it may often be withheld until crop prospects are known. A series of NebGuides on fertilizer practices are available from county Extension offices.

Soil Limitations

Soils vary considerably in their capacity to hold water. Sandy soils will hold .75 to 1 inch per foot (1.90 to 2.54 cm). Medium textured soil will store 1.5 inches (3.81 cm) while clay soils may store as much as 2 inches (5.08 cm) of available water per foot.

Available water holding capacity of soils as affected by textures are:

	Inches (cm) of useable water/6 feet (1.83 m)	
Coarse sand	4.5	(11.43)
Fine sand	6.0	(15.24)
Fine sandy loam	9.0	(22.86)
Silt loam	12.0	(30.48)

The rate of infiltration will be faster for sands than loam soils. However, silt loam soils will store the greatest amount.

Irrigation

Small grain irrigation requires excellent management and the understanding of soil-plant-water relationships. Small grains require different methods of irrigation. Winter wheat should be irrigated to provide adequate moisture after the late boot stage of growth, while spring grains need a more continuous supply of adequate moisture throughout the growing season. The difference is probably due to higher temperatures during the flowering and grain filling stages of growth when adequate soil moisture must be available to obtain maximum yields.

When to Irrigate

Crop water use varies according to humidity, wind and solar radiation. Planning irrigations according to average crop use figures is often an excellent method of scheduling irrigations. *Figure 1* shows the characteristic water use for winter wheat and is a helpful guide for irrigating.

Several methods may be used to determine when to irrigate. They are:

1. Measuring soil moisture in the root zone.
2. Calculating soil moisture depletion by using weather data and compensating for effective rainfall.
3. Irrigating at predetermined stages of growth.

Adequate soil moisture must be present at planting time to insure proper germination and, ultimately, good uniform stands. Since tillers and roots being to emerge from the crown 21 to 24 days after planting, the soil surface must be moist at this stage of plant development. Therefore it may be necessary to irrigate prior to planting.

Fall Irrigation. Fill the soil profile to a depth of 2 to 3 feet (60.96 to 91.44 cm) in the fall or winter. By not completely filling the root zone, soil moisture storage capacity is left within the root zone to take advantage of any rainfall that occurs after irrigation. Rainfall occurring soon after the profile is filled with water could percolate soluble nutrients, such as nitrate, below the root zone.

A fall application of 2 inches (5.08 cm) on a very sandy soil and 4 inches (10.16 cm) on a clay soil should be adequate to fill the soil profile to a depth of 2 feet (1.64 meters). Some room for storing winter moisture is then available.

Since water supplies are being depleted in many areas, conservation is most important. Water should be applied efficiently and rainfall used effectively to save water and energy.

Spring Irrigation. After spring growth starts, it is necessary to begin applying water based on the amount used by spring sown grains or winter wheat.

In a normal year apply irrigation water to winter wheat at the late boot stage. Avoid early irrigation on winter wheat, as rank growth will cause lodging and delayed maturity.

At the UN-Panhandle Station *(Table 1)* the highest yields occurred when irrigation was delayed until after the boot stage and then water applied according to atmospheric demand. The least water (6.26 inches) (15.9 cm) was used when the crop was left dry until flowering. Fall irrigation was applied before seeding in these trials.

The amount of water that plants use, the soil moisture stress, and some timing factors that are different for the small grains are keys to irrigating small grains successfully. *Table 2* shows the average weekly amount of water used by winter wheat and spring small grains. Tests conducted at the UN-Panhandle Station show winter wheats produce more if they are irrigated only after the late boot stage, while spring small grains have much higher yields when irrigated continuously.

Key Points for the Irrigator

1. Fill the soil profile in the fall to a depth of 2-3 feet (.60-.91 meter) if adequate moisture is available.
2. Since tillers begin to differentiate and the crown roots begin to emerge 21 to 24 days after the planting of winter wheat the soil surface must be moist at this stage.
3. Avoid applying water in March and April, as the practice encourages rank growth that may cause lodging.
4. In a normal year apply the second irrigation when the wheat plants are in the late boot

and early heading stage on fine textured soil.

5. Soils that are sandy have a low water holding capacity and may need earlier irrigation - especially if the weather is hot and dry.
6. In dry years, additional irrigation during grain filling will be needed to boost grain production. One inch of water (2.54 cm) applied every 3-4 days from flower through early grain filling stage may be advisable on sandy soils.
7. More frequent irrigations are needed on sands since they hold less water per foot of storage.
8. Some type of soil moisture device is necessary. The ordinary soil probe is a good choice for producers to make this important observation.
9. Dry layers in the soil profile should be prevented.
10. A grower producing irrigated wheat should become familiar with the water use curve of the wheat plant *(Figure 1)*.
11. Rainfall must be taken into account.
12. The effective rooting depth for the wheat plant when conditions are ideal is 4 feet (1.22 meters). However, most of the water extracted by winter wheat is from the top 2 to 3 feet (.60-.91 meters) of soil.
13. Spring small grains will need a more continuous supply of adequate moisture throughout the growing season. Start watering immediately after planting.

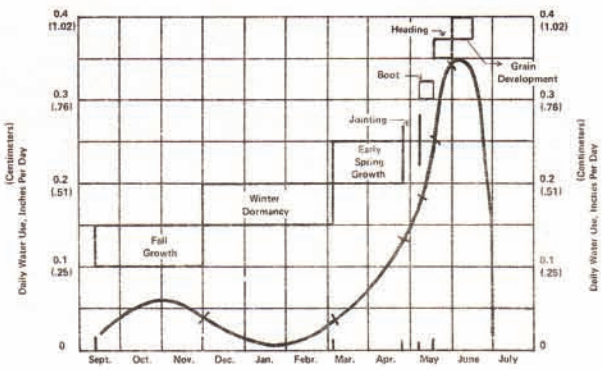

Figure 1. Characteristic water use of winter wheat.

Table 1. Average yields of wheat from 7 water treatments and amount of irrigation water applied with 5 N rates and 4 N application times for 2 years.

	1976		*1977*	
Water treatment	*Yield bu/A (kg/ha)*	*Water applied inches (cm)*	*Yield bu/A (kg/ha)*	*Water applied inches (cm)*
No irrigation	53.5 (3595)		51.2 (3441)	
Root zone wet to early boot no additional water	71.5 (4804)	5.49 (13.94)	80.8 (5430)	6.2 (15.75)
Root zone wet to flowering no additional water	98.7 (6633)	8.64 (21.95)	79.9 (5369)	10.6 (26.92)
Root zone wet to 1 week before harvest	92.6 (6222)	16.40 (41.66)	80.0 (5376)	17.2 (43.69)
Dry until early boot then irrigated according to atmospheric demand	90.7 (6095)	12.36 (31.39)	1/	11.0 (27.94)
Dry until late boot then irrigated according to atmospheric demand	90.7 (6095)	10.28 (26.11)	1/	8.9 (22.61)
Dry until flowering then irrigated according to atmospheric demand	94.4 (6344)	6.26 (15.90)	82.4 (5537)	6.6 (16.76)

1/ Due to circumstances beyond our control these plots were not representative.

Table 2. Average weekly water use of winter wheat and spring small grain based on maturity of winter wheat on 7/22 and small grains 8/5.

		WEEKLY WATER USE			
		Winter Wheat		Small grains	
Week	beginning[1/]	inches	cm	inches	cm
1	4/15	0.60	1.52	0.25	0.64
2	4/22	0.85	2.16	0.30	0.76
3	4/29	1.05	2.67	0.35	0.89
4	5/6	1.25	3.18	0.55	1.40
5	5/13	1.30	3.30	0.80	2.03
6	5/20	1.95	4.95	1.10	2.79
7	5/27	2.00	5.08	1.30	3.30
8	6/3	1.95	4.95	1.45	3.68
9	6/10	1.75	4.45	1.70	4.32
10	6/17	1.50	3.81	2.15	5.46
11	6/24	1.15	2.92	2.10	5.33
12	7/1	0.75	1.91	1.95	4.95
13	7/8	0.50	1.27	1.70	4.32
14	7/15	0.10	0.25	1.40	3.56
15	7/22	-------	-------	0.95	2.41
16	7/29	-------	-------	0.55	1.40
17	8/5	-------	-------	0.10	0.25
24	9/23	0.30	0.76	-------	-------
25	9/30	0.40	1.02	-------	-------
26	10/7	0.50	1.27	-------	-------

[1/] Dates will be adjusted for location in state and date of start of spring growth.

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LEO E. LUCAS, DIRECTOR