University of Idaho
College of Agriculture
Cooperative Extension Service
Agricultural Experiment Station

Current Information Series No. 266
February 1975

Producing Small Grains Under Irrigation In Southern Idaho

Howard B. Roylance, Extension Crop Management Specialist

Small grains — wheat, barley and oats — are an important crop in the irrigated areas along the Snake River and its tributaries in southern Idaho. White spring wheat is the predominate class of wheat grown with approximately 175,000 acres produced in 1973. A small amount of hard red spring wheat is produced in the area from St. Anthony to Idaho Falls. About 100,000 acres of soft white winter wheat were grown under irrigation in 1973, scattered through the area from Idaho Falls to Weiser. Barley is also an important irrigated crop with 375,000 acres planted in 1973. Both winter and spring types and two-row and six-row varieties are grown for feed and malting. Oats are grown to a limited extent.

This publication presents recommended cultural practices for production of small grains under irrigated conditions in southern Idaho. The introductory section, "How Cereal Plants Grow," is a brief lesson in botany, prepared for those growers who want to know the "why" as well as the "how" of grain production recommendations. The second section, "Cultural Practices," discusses practical topics such as seeding, irrigation and fertilizing.

How Cereal Plants Grow

Wheat, oats and barley have about the same general pattern of germination, root development and tillering. Therefore, the following comments and illustrations will apply to all three crops.

Germination

Adequate seedbed moisture, moderate temperature and sufficient oxygen are necessary for good germination. A deficiency of any of these factors retards or completely prevents germination. Grains do not sprout until they have absorbed at least 30 percent of their weight in water. Even at this level, germination is feeble and protracted.

The optimum temperature for germination is 68 to 72 degrees F. The minimum temperature range for germination of small grains is 38 to 42 degrees F.

A normally ripened grain sown 1 1/2 inches deep in good soil with favorable temperature conditions begins to germinate in 2 or 3 days, the coleoptile and first leaf appearing above ground in about 10 days.

The Root System

The fibrous root system of a small grain plant consists of two parts:

1. the primary or seminal root system
2. the permanent or adventitious root system

Primary or Seminal Roots

When a small grain seed is placed in the soil under favorable conditions for germination, a small root breaks through the seed coat. Several additional roots appear on both sides of the first root to complete the primary root system. These primary roots form only a small part of the total root system of the plant. Their function is to absorb water necessary for the growth of the young plant, especially in its early stages of development. They appear to be functional throughout the life of a plant. How much they develop and how deep they grow are influenced by the texture of the soil and seeding depth of the grain.

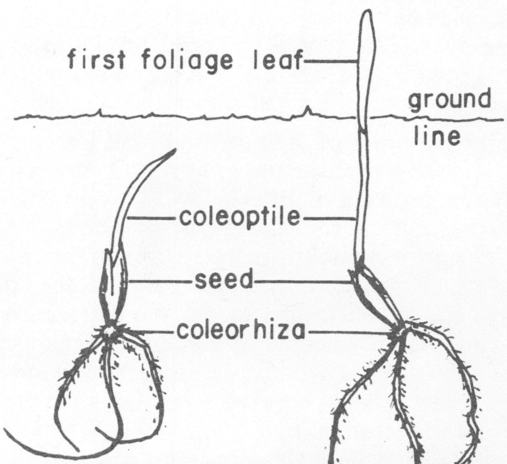


Fig. 1. Germinating barley seed and early seedling development.

When grain is planted 1 1/2 to 2 inches deep, the seminal roots reach their maximum development and penetrate to a depth of 8 to 12 inches or more. Where the grain is sown at greater depths, the roots grow feebly because the food reserves of the endosperm are chiefly used to help the coleoptile grow and reach the light above the ground.

Permanent or Adventitious Roots

The first permanent roots appear at the tillering node about 1 inch below the ground line. They arise from the lower nodes of the main stem and each of its branches near the ground line. These roots are always produced at about the same distance below the soil surface regardless of planting depth. The adventitious roots do not begin to appear until long after the leaves of the first or second buds have come above the ground. New adventitious roots continue to break out from the nodes of each of the straws until May or June. By this time an extensive root system has been established. About 60 percent of the roots are found in the upper 8 to 12 inches of the soil. The rest extend to greater depths. In deep loams a few occasionally penetrate 4 or 5 feet or more.

Early Growth

Soon after the first primary root appears, the coleoptile or leaf sheath starts growing upward and the first foliage leaf emerges from the top of the coleoptile. The coleoptile (second leaf) is very important to the emergence of the seedling plant because it is well adapted to soil penetration. The length of the coleoptile depends upon the depth of seeding but usually will not exceed 3 inches. Short-strawed varieties usually have shorter coleoptiles.

In crops drilled about 1 1/2 to 2 inches deep in the ordinary way, the coleoptile comes to the surface or slightly above it. With deeper planting, the coleoptile may not reach the surface. Once above the soil surface, the coleoptile stops growth. The leaf sheath opens and a third leaf (first foliage leaf) breaks through the tip. This third leaf becomes a functional seedling leaf. It becomes green after emergence and is the first leaf to carry on photosynthesis. All subsequent leaves and the growing point emerge through the coleoptile.

The foliage leaves have little or no soil penetrating power and will not emerge if the coleoptile fails to reach the soil surface because of soil crusting or planting depth. Under these conditions a poor stand results. The leaves continue growing for awhile but remain yellow and crinkled below ground or just under the soil crust.

The growing point of the potential head (terminal bud) is always located above the uppermost node in each straw. Generally, the growing point is below the soil surface until nearly 30 percent of the mature plant height has been reached. The growing point emerges through the coleoptile and is always above the soil surface as soon as the node can be felt near the soil surface. This delayed emergence of the terminal bud is a valuable protective mechanism and should be considered when investigating frost, wind or hail damage. Cereals will survive extensive damage to the leaves and crown if the terminal bud is not killed. When developing heads are high enough above the soil surface to be grazed off, pasturing may reduce grain yield.

Maturity is delayed if the plant suffers an extensive loss of early foliage leaves. Potential plant development, including number of spikelets, is determined during the late seedling stage and before tillering. Growing conditions at this early growth stage do influence final crop yield. For example, early season drought or high temperatures may limit the final yield. Cultural practices such as early seeding and soil moisture conservation usually help to avoid such yield-limiting factors.

Tillering

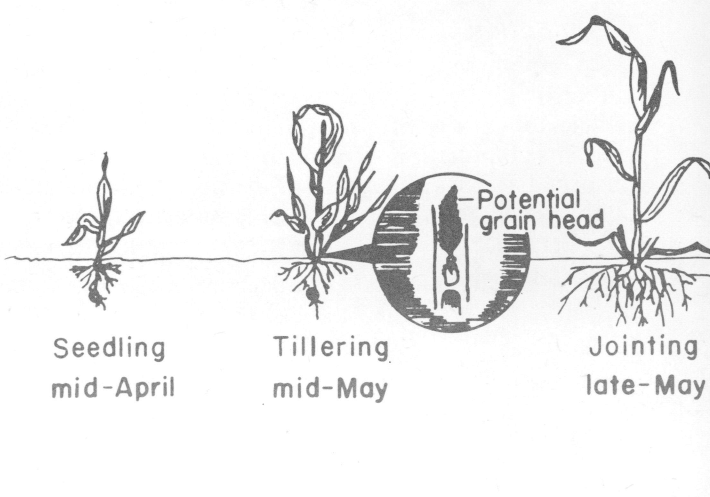
Production of stems near the surface of the soil is known as "stooling" or "tillering" of the plant. It is a normal process of branch formation in cereals and grasses. The depth at which tillering begins is regulated chiefly by the light perception of the plant and by seeding depth. A plant grown alone from a single grain in good soil may possess a hundred stems or more in the spring. It may develop heads yielding several thousands of grains at harvest.

As grain is normally grown in the field, tillering may be stopped after formation of a small number of stems. Plants with only 2 or 3 stems are common. Some stems may die off even after they have reached a height of 3 to 6 inches. This is most frequently observed in dry seasons when the permanent root system of each stem has developed too late or has dried up before becoming well established. Grains as commonly grown rarely produce more than 3 or 4 fully developed tillers.

The tillering activity of small grains varies with environmental conditions and variety. In general, winter grains tiller more than spring grains. Two-row barley generally tillers more than six-row barley. Early planting, low rates of seeding, large seed, moderately warm soil and high soil fertility all promote tillering.

Grain normally make a continous, moderate growth in height until late May or early June when it reaches the heading stage. From this stage on, the straw lengthens rapidly. The maturing head emerges from the uppermost leaf sheath usually from mid-June to mid-July. This stage of development is referred to as shooting.

Fig. 2. Cereal growth rate is moderate until the heading stage and fast from then until maturity. Ripening is normally 30 to 35 days after flowering.



Lodging

Lodging may occur when small grains are in the boot but is more likely to occur after the grain has headed or after the heads are partially or fully filled. When lodging occurs early and the straw is green, the heads of a lodged crop tend to stay upright. The straws are bent upwards at each node until the uppermost internode is again vertical. Crop losses may be comparatively small. If lodging takes place late in the season where the nodal tissue is dead or dying and the grain is formed in the head, the straw and heads remain lodged and losses may be severe.

Cereal varieties differ considerably in their resistance to lodging because of inherited root and stem characteristics. Lodging is encouraged by crowding. When plants are crowded, they receive insufficient light. This causes the stem to elongate. The straw will be weak because thickening and lignification of the mechanical tissues of the straw are greatly checked in dull light. The strength of the straw of unlodged plants is chiefly due to the thick, lignified cell walls. Lodging caused by excessive stem elongation and weakening of the straw can be minimized by reduced seeding rates, wider row spacing, and by avoiding overfertilization with nitrogen fertilizer. With several of these factors working together, lodging is almost certain to follow.

Cultural Practices

Seedbed

The seedbed should be as level as possible, firm and moist, well-worked and free of clods. A firm seedbed will provide good contact between the seed and moist soil particles, important for good germination and early seedling growth.

Time of Planting

Small grains are cool weather crops. They should be planted early in the spring so they can grow and develop before temperatures get too high. Time of planting will vary somewhat from year to year, from area to area and from one soil type to another. Approximate planting times are as follows:

Boise Valley area - Late February and March
Magic Valley area - Mid March and early April
Upper Snake River area - April

Early planting has at least three advantages:

An early planted crop will naturally mature earlier. This saves on irrigation water by better use of spring rains and by reduced evaporation and transpiration. Furthermore, early planted grain will tiller better than late-planted grain, resulting in thicker and better overall stands and perhaps permitting somewhat lower seeding rates. Early planting also normally results in higher yields and lower protein in the grain which is desirable in soft white wheat and malting barley.

Rate of Seeding

Experiments at the Research and Extension Center, Aberdeen, many years ago indicated that seeding 80 to 100 pounds per acre of wheat, barley or oats will provide maximum yields. Farmer experience in the Upper Snake River valley substantiates this rate of seeding. Farmers in the Magic Valley area generally use seeding rates of 100 pounds, while in the Boise Valley area farmers use 150 pounds or more. Apparently the higher seeding rates are necessary in the Boise Valley area because the higher spring temperatures do not favor good tillering. The later the seeding date, the less the grain will tiller or stool. Therefore, the seeding rate should be increased for later planting.

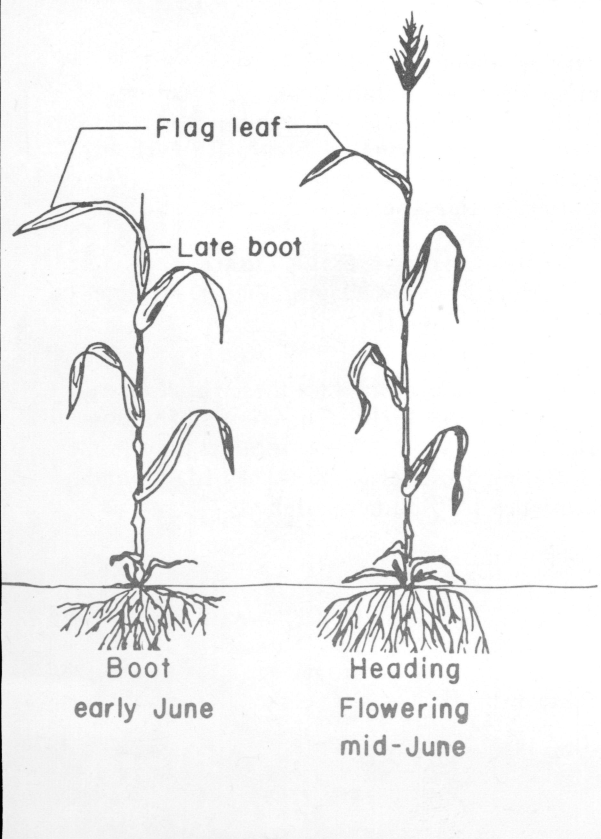
Depth of Planting

Grain should be planted relatively shallow, about 1 to 1 1/2 inches deep, into good moisture. Small grains require a minimum soil temperature of about 34 to 36 degrees F for germination. When planted shallow, the seed will be placed in an area that will warm up first and thus will tend to germinate and emerge rapidly.

Irrigation

A grower should check at the 6 to 12-inch depth to determine the need for the first irrigation. Research shows that it is not necessary or desirable to apply the first irrigation until the available soil moisture in the root zone has fallen to about 45 percent. The first irrigation should wet down to the sub-moisture or approximately 12 inches. In other words, use a light irrigation. Excessive irrigation leaches much of the available nitrogen beyond the root-feeding zone and tends to reduce yields.

A second irrigation should be applied as necessary, probably between boot and heading stages. Time will vary depending upon soil type, depth and general weather conditions. During this time, plant growth is almost at a maximum and the grain should be kept at a fairly high level of moisture. The period from late boot to soft dough is especially critical. The grain must be kept fairly wet. Soil moisture should be maintained at the 50 percent level or above at the 12 inch depth. Irrigation will probably be needed when the grain is in the soft to stiff dough stage also. If soil moisture level is at field capacity when the grain is in the stiff dough stage, any further irrigation will not be needed. The kernel has reached full physiological maturity and from then on it is a matter of drying. In many cases,



growers over-irrigate grain early in the season and again late in the season after the plants have essentially reached maturity.

Fertilization

The grain crop must be adequately fertilized to obtain maximum yields. Since small grains are heavy users of nitrogen, nitrogen fertilizers must be applied. Usually phosphorus, potassium and other elements will be adequate to satisfy the needs of the crop. A fertilizer guide for spring cereals is available from Extension agricultural agents.

Soil testing for nitrogen and phosphorus is suggested. In general, apply 40 to 80 pounds of nitrogen following sugar beets or potatoes. Where the straw is plowed under, apply about 120 to 160 pounds of nitrogen. Where the straw is baled and removed from the field, the grain should receive about 60 to 100 pounds of nitrogen. Barley is more likely to lodge than wheat or oats. To minimize lodging, excessive rates of nitrogen should not be applied.

These suggestions on cultural practices apply to spring wheat, oats and feed barley. Winter barley and malting barley require somewhat different handling.

MALTING BARLEY

Malting barley has become an important crop in southern Idaho the last 5 years. Demand for malting barley is expected to increase in this area. Growers receive a premium for growing high-quality malting barley and the cost of production is only slightly above that of feed grains. Growers who anticipate planting barley for malting should plant early because early planting leads to better maturity and plant development during the early summer when temperatures are usually moderate. This will result in higher yields and lower protein.

Fertilize malting barley carefully to achieve maximum yields of acceptable grain. Too much nitrogen will increase the protein in the grain so that it will not be acceptable. The maximum protein permissible in malting barley is about 13 percent with a preferred range of 10 to 12 percent for two-row malting barley. Any good grain farmer can produce high quality malting barley. Malting barley is nothing more than producing good seed of acceptable varieties because in the malting process the maltster wants germination as near 100 percent as possible.

One of the most serious problems in malting barley is skinned and broken kernels. This occurs during harvesting and can be minimized by proper combine adjustment. Skinned or broken kernels are objectionable because they reduce the yield of malt. Damaged grain does not germinate evenly or completely. Another problem which may occur is the incidence of storage insects. Most malting barley is stored for 30 days or more before shipping to the malt house. Malting barley buyers report that the red flour beetle and the Sawtooth grain beetle are primary problems. Infestation by these insects can be prevented by proper sanitation methods and use of approved insecticides.

Occasionally a lot of malting barley is rejected because protein is over 13 percent. The high protein is usually caused by over-fertilization with nitrogen or a shortage of water during late plant development. Even though the barley may not meet malting standards, it is still good feed barley.

WINTER BARLEY

Adapted varieties of winter barley will perform well under irrigation. Considerable improvement has been made in recent years in the development of winter-hardy, higher-yielding barley varieties. Tests at Aberdeen indicate that winter barley will survive possibly 4 years out of 5 in the Aberdeen area. It has survived satisfactorily the past 7 years. Winter barley is not suggested north of Idaho Falls because of the risk of winterkill.

Winter barley can be grown in the Magic Valley and Boise Valley areas with little or no risk of winterkill. One advantage of winter barley is that it will generally mature earlier than spring barley. This means it should use less irrigation water and may allow for better distribution of labor during harvest. Winter barleys will normally equal or exceed spring barleys in yield.

Time of Planting

The optimum time for planting winter barley in the Aberdeen-Blackfoot area is between September 10 and September 20. A grower should not normally plant later than October 15 because barley planted after October 15th is more subject to winterkill and soil crusting. Late fall plantings will also mature late the following year so the advantage of planting a winter barley is essentially lost.

Winter barley can be planted in the Boise Valley until about November 1. However, it is much better to plant during early October. Rates of seeding and fertilization for winter barley are essentially the same as for spring barley.

CEREAL VARIETIES

Cereal varieties suggested for Idaho irrigated areas include:

White spring wheat — Fielder, Twin
Red spring wheat — Borah, Peak 72, Fremont
Feed barley, 2-row spring — Caribou, Otis
Feed barley, 6-row spring — Steptoe, Steveland, Woodvale, Gem, Vale 70
Feed barley, 6-row winter — Schuyler, Luther, Kamiak
Malting barley, 6-row — Traill, Larker, Karl
Malting barley, 2-row — Klages, Shabet, Piroline, Vanguard, Moravian III
Oats — Cayuse, Park

Descriptions and agronomic data for these varieties are described in University of Idaho Current Information Series No. 214, Spring Wheat Varieties for Southern Idaho; No. 215, Barley Varieties for Southern Idaho, and No. 217, Oat Varieties for Southern Idaho.

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, James L. Graves, Director of Cooperative Extension Service, University of Idaho, Moscow, Idaho 83843. We offer our programs and facilities to all people without regard to race, creed, color, sex, or national origin.

7M 2-75