

AGRONOMY

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Small Grain Production for Iowa—Spring

Spring small grain types

Oat is the most popular spring small grain in Iowa and the only one reported by county in the Iowa Agricultural Statistics. This makes it difficult for producers to decide if other grains might sometimes be more suitable. Results of spring small-grain variety trials at Iowa State University can help. From 1980 to 1989, average yields for barley, oat, and hard red wheat were 69, 97, and 39 bushels per acre, respectively—higher than average, but attainable with good management.

Triticale, a cross between wheat and rye, is self-pollinated and higher in protein and lysine than other small grains. Variety trials have not been conducted with triticale in Iowa, but in other trials it has yielded 85 percent of hard red wheat. It is more likely to be infested with ergot than barley, wheat, or oat.

Spring rye yields significantly less than winter rye and is a poor selection except in very unusual situations. Rye is cross-pollinated. Its flowers stay open longer than those of other small grains, making it more subject to ergot. Variety trials are not conducted in the upper Midwest with spring rye.

Pennsylvania State University and the U.S. Department of Agriculture/Agriculture Research Service have released a naked-seed oat, Pennuda. At threshing, the groats are freed from the hulls. Because hulls constitute 30 percent of the yield of hulled oat, producers should expect a similar reduction in yield compared to a hulled variety. Also, without hulls for protection the embryos can be damaged during harvest. A germination test of seed is therefore imperative, and seed treatment with a fungicide is advisable. Planting rate is 30 percent less by weight than a hulled variety. Harvest at higher kernel moisture than other small grains; adjust the combine to reduce kernel damage. Pennuda will probably require artificial drying for safe storage. Because this oat is different, producers need to know how they plan to use it before planting it.

Spring wheat trials were conducted at Ames and Kanawha. The average yield was about five bushels per acre greater at Kanawha than Ames (42 versus 37), probably because spring wheat matures in mid-July and may be more affected by hot weather in central Iowa than in northern Iowa. Barley, which matures earlier than spring wheat, yielded about five bushels per acre better in central Iowa than northern Iowa (72 versus 67). In addition to earlier maturation, barley may be more tolerant of higher air temperatures.

Uses

Most small grain can be sold for food as well as for feed. Producers usually receive higher prices for food grains, but quality standards are hard to meet. Barley produced in Iowa is generally unacceptable for brewing; consider it a feed grain. Although triticale makes a more nutritious bread than wheat, it has only a limited market as a speciality food grain; consider it a feed grain also.

Hard red spring wheat produced in Iowa may be acceptable for bread flour. In years with good plant-available moisture, however, the kernels become plump with additional starch, reducing the protein and making it less valuable for milling. Under these conditions, hard red wheat is likely to be graded soft red wheat.

Mills are designed to process either hard red or soft red wheat, not both, and they market hard red or soft red wheat products, not both. A hard red mill can blend starchy hard red with good quality hard red wheat and make a satisfactory product. Alternatively, a soft red mill can blend starchy hard red with good quality soft red wheat and make a satisfactory product. This is only worthwhile, however, if starchy hard red wheat is available at a reduced price.

Durum wheat is used to make spaghetti and macaroni. It is highly unlikely that durum wheat

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produced in Iowa will meet food grain standards, and it generally yields less than hard red wheat.

Less than 10 percent of oat produced in the United States is processed for food; over 80 percent is used as feed grain. Only 35 to 40 percent leaves the farm where it is produced. A large volume of oat can therefore be converted from feed grain to food grain if the price is right and if it meets test weight and other quality standards.

Bushel weight

You can increase the test weight of oat by conditioning it with a steel flighted auger. With the auger set at a steep angle, run it fairly fast and partially full. This wears the tips off the kernels, increasing the bushel test weight. It may take more than one pass to get the desired test weight, but be careful not to damage the kernels.

With a one-quart dry measure and a dietetic scale, you can weigh samples to get bushel-weight estimates. Pour grain into the center of the measure from a height of two inches. Strike off the excess grain with a wooden ruler. Weigh the measured grain. A bushel contains 32 quarts; therefore, the weight of the grain multiplied by 32 is the estimated bushel weight.

You can make a one-quart dry measure from a large can. An official one-quart dry measure holds 38.3 ounces of water. Place the can on the scale, zero the dial, add 38.3 ounces of water, mark the height of the water, and cut the can to the mark. Place the can on the scale, zero the dial, and add the water to the can again to check the accuracy of the cut.

Comparing small grains

One method for evaluating spring small grains is to convert them to corn feed units for a livestock finishing ration. The percentage of small grain equivalent bushels compared to corn is determined as follows: (small grain bushel weight / corn bushel weight) X percentage corn feed value (pound per pound). This formula results in the following approximate percentage corn equivalents: barley and triticale (48/56) X 95% = 81%; oat (32/56) X 85% = 49%; and wheat (60/56) X 105% = 113%. Applying these percentages to the variety trial yields gives corn-equivalent bushels per acre for barley, oat and wheat of 56, 48, and 44, respectively.

Production cost

You can estimate the cost of small grain corn-equivalent feed units. Assume the cost per acre of small grains for all fixed and variable costs is \$180, with one-third assigned to straw (\$60) and two-thirds to grain (\$120). Using corn-equivalent bushels for barley, oat, and wheat from variety trials (56, 48, and 44) results in \$2.14, \$2.50, and \$2.73 per bushel, respectively. This means that if the production cost of corn is more than

\$2.14 per bushel, barley is a cheaper feed grain. If the straw cannot be used or sold and all costs are assigned to the grain, the cost per bushel changes significantly.

Barley, triticale, and wheat can make up to 50 percent of the grain in a finishing ration without loss of efficiency; oat, 10 to 15 percent. Triticale's high protein and lysine content makes it a good feed grain, especially for young animals, but its tendency to get ergot is a detriment.

Variety selection

In addition to variety yield test reports, disease resistance is an important factor in choosing small spring grains. Scab, powdery mildew, tan spot, septoria, helminthosporium, barley yellow dwarf, and rust can be significant problems.

Several species of *Fusarium* cause scab in cereals and are present in nearly all crop residues and soils. Whether scab will be a problem in a given year depends on weather conditions during small grain flowering, when florets are infected. Susceptibility to scab is wheat > triticale > barley > oat. In the six years from 1985 to 1991, scab was a severe problem one year in Iowa on wheat and triticale.

Powdery mildew fungus is generally specific to each small grain type. It is most common in a cool, wet spring. In the same six-year period, powdery mildew was a severe problem one year.

Tan spot also is more likely to occur during cool, wet weather, whereas septoria and helminthosporium are problems at warmer air temperatures and when plants are wet from rain or dew for extended periods. Septoria was a major problem one year and tan spot and helminthosporium were minor problems during the six-year period.

Barley yellow dwarf virus, called "red leaf" on oat, is spread by aphids. Aphids do not survive the winter in Iowa but are blown in from the south in the spring. They may have the virus when they arrive or pick it up feeding on perennial grass hosts. Barley is more susceptible than wheat to barley yellow dwarf. Some types of oat are resistant. Rust resistance varies among spring small grains; select resistant varieties.

Grain infested with ergot and/or scab causes problems when fed to livestock, especially swine. Scabby grain can produce two toxins: vomitoxin causes swine to vomit, and zearalenone causes pregnant females to abort. Test scabby grain at a Veterinary Diagnostic Laboratory to determine if it is producing either toxin.

Grain with 0.3 percent ergot infestation is unfit for food or feed. Continual feeding of grain with 0.1 percent ergot infestation may result in reduced feed intake, lameness, gangrene, and lack of milk production in swine after farrowing.

Conditioning grain with seed condition equipment, especially a gravity table, removes some of the ergot sclerotia and some scab-infected kernels. The safest way to dispose of infested grain is to dilute the grain and feed it to non-breeding ruminants. Consult your veterinarian.

Fungicide

Apply non-systemic fungicide to small grains after emergence of the flag leaf to protect it from plant diseases, but apply systemic fungicide prior to flag leaf emergence. Fungicides will not control scab, ergot, or barley yellow dwarf, but they do increase grain yields in Iowa when some other diseases are present. Plant diseases are not a problem every year, however, so you may not be able to justify an annual fungicide expense of \$9 to \$12 per acre plus application cost. You can monitor your grains and apply fungicide(s) when disease(s) appear, but this takes dedication.

Growth regulator

When lodging is a problem, growth regulator can reduce plant height and lodging and in some cases increase yields, but it does not eliminate lodging in Iowa. When lodging is not a problem, growth regulator reduces yields, sometimes significantly. Growth regulator costs \$2 to \$3 per acre plus application expense. It tends to increase the incidence of plant disease, so use it in conjunction with fungicide. Growth regulator is not cleared for all small grains. Because growth regulator's effect on yield is not always positive, select varieties resistant to lodging.

Planting date

Plant spring small grains as early in the spring as soil conditions permit. In any given year, the earlier the planting the greater the yield potential. Small grains germinate when soil temperature is a few degrees above freezing, but development is slow. If plants have not "jointed" (the first node and growing point are below the soil surface) and a freezing air temperature occurs, the leaves may be frozen but little other damage will occur. If the soil freezes, however, and soil temperature is in the upper 20s, some damage can occur. If you plant early in cold soil, seed treatment with a fungicide is advisable.

For oat in central Iowa, maximum yield occurs if planting is late March to April 15. Following April 15, yield drops about 10 percent per week during April and 15 percent per week during the first two weeks of May.

Pre-plant tillage

Keep tillage at a minimum to reduce cost and soil erosion. You can get good yields when small grain seed is broadcast, but yields usually increase when seed is planted with a drill. The drill provides good seed distribution, uniform planting depth, and, when

equipped with press wheels, good seed-soil contact. Dual press wheels beside the row allow planting in wetter soil. They are less likely than press wheels directly on the row to cause crusting over the seed when planting is followed by a hard rain. Properly operated, no-till drills are excellent for planting small grains.

Row width

Row-width studies have been conducted in Iowa with 3-inch, 6-inch, and 12-inch rows. Yields and lodging were equal for 3- and 6-inch rows, and both were superior to 12-inch widths. A row arrangement study also was done. Seed planted north-south in 6-inch rows was compared to a crisscross method where half the seed was planted north-south in 12-inch rows and half was planted east-west in 12-inch rows. The 12-inch crisscross was equal to the 6-inch and superior to the 12-inch rows, even though there was visible evidence of tractor track compaction across the plots. Be careful not to compact the soil with oversized equipment.

Planting rate

A rate-of-planting study has been conducted for four years in central Iowa. Seeding rates were 15, 30, 45, and 60 seeds per square foot. The data, shown in Figure 1, are in corn-equivalent bushels per acre. To convert to bushels per acre for a small grain, divide the data in the table by the grain's percentage corn equivalent (for example, oat at $40.0 \text{ bu/A} / 49\% = 81.6 \text{ bu/A}$). Seed used in this study had high germination percentages and was treated.

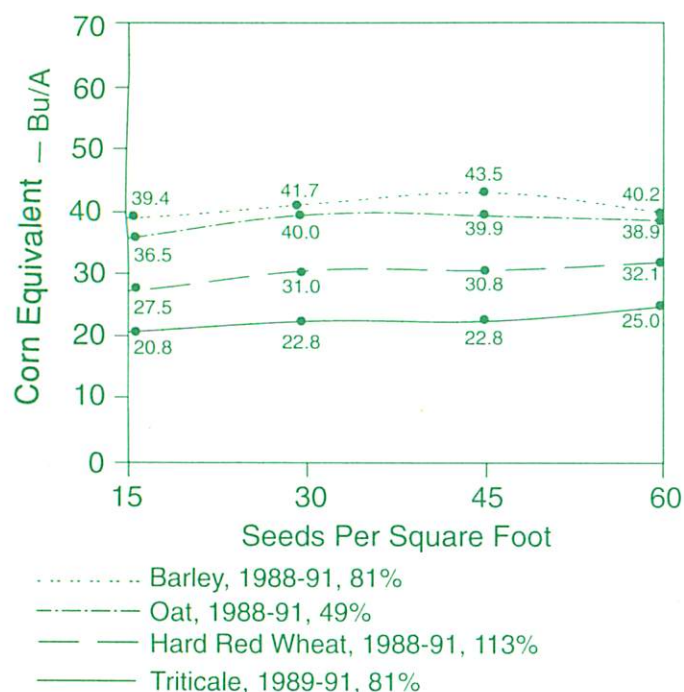
The problem in determining planting rate lies in knowing how many seeds there are in a pound. During the four-year study, the number of seeds per pound varied as follows: barley, 10,300 to 14,600; oat, 13,400 to 19,700; triticale, 11,000 to 19,800; and wheat, 10,800 to 15,100. Using averages, you need 100 pounds of barley, 85 pounds of oat, 65 pounds of triticale, and 90 pounds of wheat to get about 30 seeds per square foot. Seed tested for germination at the Iowa State University Seed Lab is also tested for seeds per pound. Planting seed that has not been tested for germination, weed seed, etc. is foolish, at best.

If a producer has a poor stand, the data in Figure 1 can be used to estimate the yield potential. For example, oat yield at 15 seeds per square foot is equal to 91 percent of the yield at 30 seeds per square foot.

Fertilization

Pounds of nitrogen, phosphate, and potash in a bushel of wheat, barley, and oat are 1.3-0.63-0.38, 1.1-0.41-0.36, and 0.7-0.25-0.19, respectively. Pounds of nitrogen, phosphate, and potash per ton of wheat, barley, and oat straw are 13-3-23, 15-5-30, and 13-8-40. It is doubtful that it would pay to apply phosphate or

Figure 1. Spring small grains rate of planting — Ames.



potash when the soil test is medium or higher, unless there is a forage seeding.

Oat management studies were conducted at six Outlying Research Centers using standard farm equipment with zero and 90 pounds of nitrogen per acre. Yields were 68 and 66 bushels per acre, and 1.2 and 1.4 tons of straw per acre. The studies were conducted at three centers the next year with zero and 45 pounds of nitrogen per acre. Yields were 68 and 74 bushels per acre, and 2.4 and 2.6 tons of straw per acre. In most of the studies, the oat followed soybean.

A nitrogen-response study was conducted with hard red spring wheat in conjunction with hard and soft red winter wheat in southeast Iowa for three years. Rates were 0, 50, 100, and 150 pounds nitrogen per acre. Yields for the zero rate were equal to other rates, even though in two of the three years the nitrogen needed for the grain and straw was more

than 50 pounds. One year the wheat followed corn, and the other two years it followed soybean.

In two of the three years, lodging was not a problem regardless of nitrogen rate. The other year, lodging was a problem and was more severe at the higher nitrogen rates. Plant diseases were also a problem that year, and heavy rainfall accompanied with high winds occurred at harvest maturity. Lodging is therefore a complex issue involving plant-available moisture, nutrient availability, and rainfall accompanied with high winds, not simply "too much nitrogen."

Some states use nitrate-nitrogen tests for the upper one to two feet of soil to determine nitrogen rates for small grains. Although detailed studies have not been conducted in Iowa, they might be desirable because nitrogen recommendations based on grain and straw removal do not appear to be adequate.

Harvest

For safe storage, spring small grains should be 13 percent moisture or less. Whether to harvest standing or from the windrow depends on the situation. If green weeds are present, windrowing allows them to dry prior to combining. Some food processors, however, do not like grain harvested from the windrow. If rainfall and cloudy weather occur following windrowing, the grain may dry slowly, initiating germination and reducing the quality of the grain.

Additional information

Results of barley and oat variety tests in Iowa are published in *Wheat and Barley Tests*, AG-6, and *Iowa Oat Tests*, AG-10, available from Publications Distribution, Ames, Iowa 50011, or from county extension offices. Spring wheat variety tests are no longer conducted in Iowa, but variety information on spring wheat and other spring small grains is available from South Dakota State University, Brookings, S. Dak. 57007; North Dakota State University, Fargo N. Dak. 58105; University of Minnesota, St. Paul, Minn. 55108; and the University of Wisconsin, Madison, Wis. 53206.

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