10-1-1979

Barley in South Dakota: Cultural Practices, Harvesting, Varieties, Utilization, Services

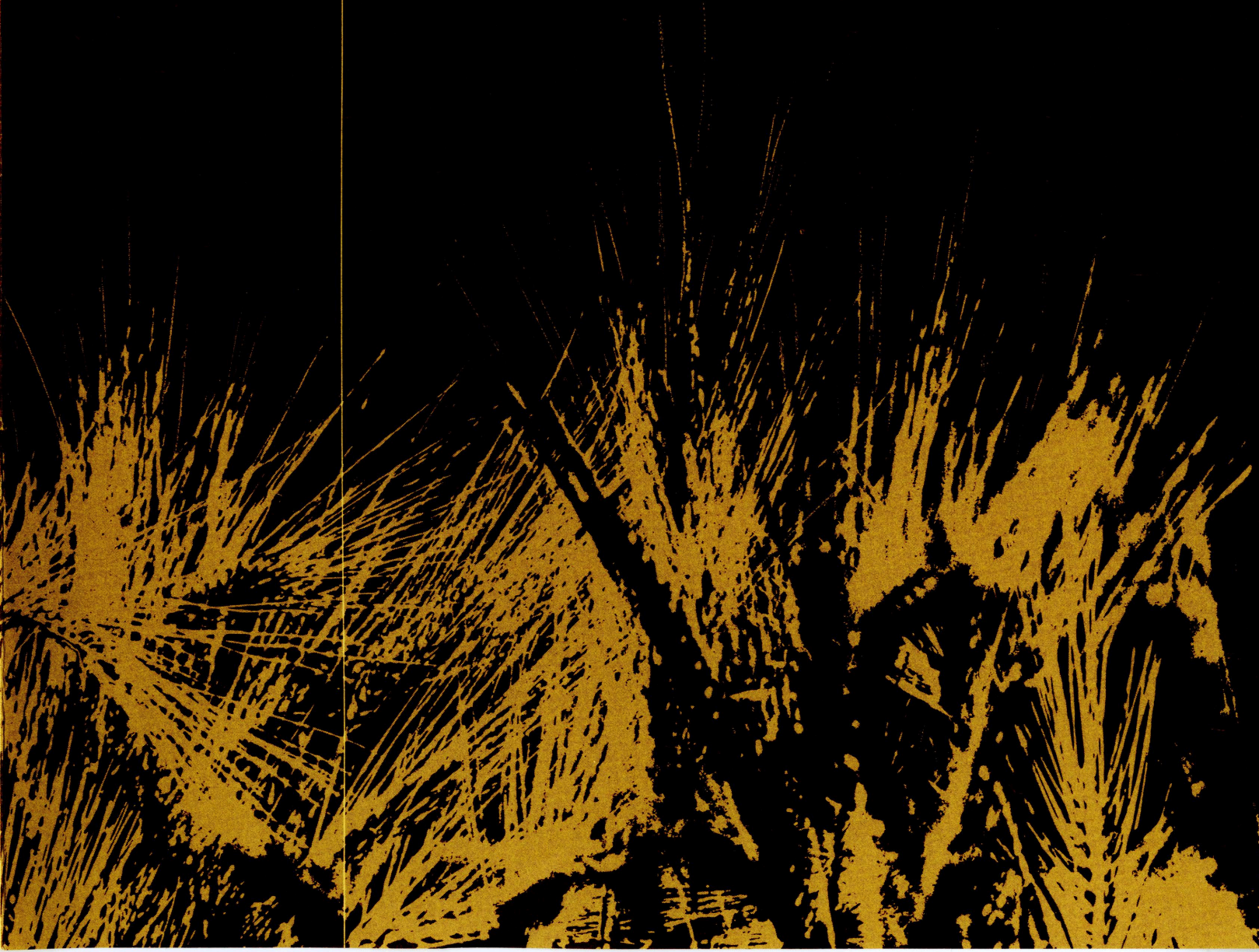
P. Price

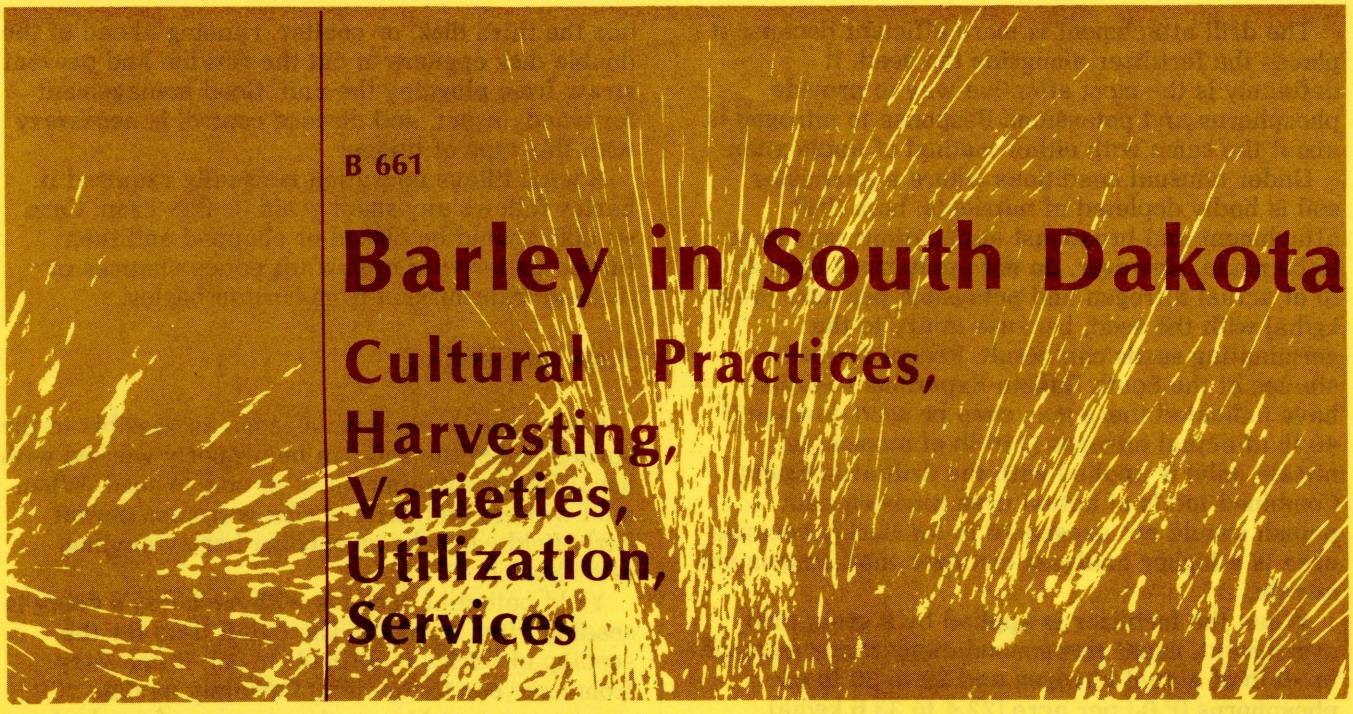
B 661

Barley in South Dakota

Cultural Practices, Harvesting, Varieties, Utilization, Services

Agricultural Experiment Station • South Dakota State University





B 661

Barley in South Dakota

Cultural Practices, Harvesting, Varieties, Utilization, Services

Phil Price
Research Agronomist
Science and Education Administration
Agricultural Research
USDA, Plant Science Department

Barley is one of the few crops which can be grown statewide in South Dakota. It grows well in our climate, can be produced dryland or irrigated, is seldom subject to frost damage, costs about half as much as corn to produce, and lends itself well to mechanization in all phases of handling. It is a dual purpose crop; it can be sold for the malting premium or used profitably as a feed grain for livestock.

Cultural Practices

Crop Rotation

Before general use of commercial fertilizers, the rotation system or crop sequence which the grain producer used played an important part in barley yields. The highest yields were obtained on those rotations including a cultivated crop and a legume.

Today, soil tests and fertilizer applications permit the farmer to ignore older crop rotation practices. Nevertheless, the crops which precede barley affect soil moisture and tilth and barley diseases. If certain herbicides are used on the preceding crop, it may not be possible to seed barley on that land for one or more years.

Legumes, such as alfalfa and sweet clover, deplete the moisture reserves in the soil, and corn stubble may carry scab organisms which attack barley in both seedling and mature stages.

Soil tilth is probably in its best state following soybeans or a sudan-sorghum hybrid which has been used as green manure.

Barley is often used as a companion crop for underseeding of legumes and grasses.

Soil Fertility

More farmers would find barley a profitable crop if they grew it on land with adequate fertility. Barley responds well to the application of fertilizers, especially nitrogen and phosphorus. The response is marked increase in yield and an improvement in bushel weight, straw strength, and uniformity of ripening.

Soil temperatures in early spring are often too low for the release of sufficient nutrients from organic sources to permit optimum plant growth. Therefore, the application of readily available nutrients is essential to promote maximum growth and development of the barley plant.

Farmers who manage their land properly to avoid nutrient loss through soil erosion and apply fertilizer to compensate for nutrients taken off with the crop will achieve high productivity.

Periodic soil tests and good record keeping are essential aspects of evaluating existing soil fertility. A representative soil sample and accurate information on previous cropping practices, soil type, and the location of the field will give a soil analyst the background to provide recommendations for the amount and type of fertilizer your barley will need.

The two common methods of applying fertilizer are by grain drill attachment and broadcasting on the soil surface followed by incorporation.

The drill attachment is more efficient because it places the fertilizer alongside the seed. It definitely is the most effective way to provide phosphorus and potassium. Response to nitrogen is about the same with either method of application.

Under unusual conditions where a particular soil is badly depleted of nutrients, both drill attachment and broadcast applications may have to be made. However, **do not** apply more than 40 lb of actual nitrogen and potassium per acre (44.8 kg/ha) with the seed, because injury to the germinating seeds can result. Recent fertilizer studies at the South Dakota Experiment Station have indicated there may even be seed damage if 40 lb of actual nitrogen (120 lb of ammonium nitrate only) is applied with the drill attachment. Combined totals of actual urea nitrogen plus potash should not exceed 20 lb for barley because urea is a higher analyses fertilizer than ammonium nitrate.

When the fertilizer is applied by a grain drill attachment, usual recommendations range from 20 to 30 lb of actual nitrogen and 20 to 30 lb of phosphorus (P_2O_5) per acre (22.4 to 33.6 kg/ha). Little or no nitrogen is recommended where fallow, a legume crop, or a heavy application of manure preceded the barley crop. Phosphorus and possibly potash (potassium) may be required, however, depending on soil test levels.

Additional information on required soil fertility for higher crop yields is contained in Fact Sheet 679, "Fertilizing Barley."

Seedbed Preparation

The type of tillage used in the seedbed preparation will depend on individual farming operations, cropping practices, soil type, annual precipitation, and topography.

The purposes of tillage are to improve the physical condition of the soil, reduce competition from weeds, and prepare a good seedbed. Some types of tillage equipment mix the soil (regular moldboard plow or chisel plow). These are usually followed by harrows, field cultivators, or other implements which produce a smooth, finely pulverized condition which allows the soil to come in close contact with the seed. The plow with a packer attachment and pony express drill behind is an excellent once-over seedbed preparation and planting method under certain conditions.

For conservation of fuel, labor, and moisture, reduced tillage or no-tillage methods of land preparation and seeding are quite effective. These implements (such as the large blade sweeps) cut beneath the soil surface without inverting the tilled layers. Yields from these methods vary, but not greatly, from those obtained using other methods.

To penetrate stubble, special drills are needed. A triple disk press drill works quite well. This drill has the third disk, or coulter, running ahead of the double disk openers to cut the residue and prevent straw from plugging the unit. Good management for weed, insect, and disease control is necessary with this type of tillage.

A good tillage operation is usually required if barley follows any small grain or flax crop. Corn stubble should be disked or chopped and then turned under with a plow to reduce chances of disease transmission from corn to barley.

Time of Seeding

Barley should be sown as soon as possible in the spring. When the soil can be properly worked with usual farming equipment, it is time to seed. When mild winters and early spring warmups permit early field work, begin seeding barley anytime after March 15.

Yield potential declines with each day's delay in seeding after April 15. The cutoff date for the seeding of barley is difficult to set; it can vary from one year to the next. Certainly as time progresses past May 1, the chances of producing plants with normal heights, good tillering, and large spikes are reduced and the sowing of a row crop instead is recommended. Late planted fields always suffer more damage from diseases, pests, and summer drought than do the early seeded fields.

The recommended barley varieties (Table 1) are quite cold tolerant. The sown grain of these varieties is not damaged by a prolonged period of cold soil temperatures before germination. Young plants will survive frost and brief periods of snow cover following germination.

It has been firmly established by Experiment Station trials and farmer experience that barley planted early will usually out-yield late plantings and produce better quality grain for feeding and malting purposes.

Rate and Depth of Seeding

The purpose of spacing crop seeds with a drill is to obtain maximum productivity per acre without wasting seed and reducing grain quality. Many growers do not achieve this because they sow barley at too high a rate.

Some seed companies still recommend a seeding rate of 90 to 110 lb (1.8-2.3 bu) of grain per acre (1.0 to 1.2 q/ha). Rates this high waste seed and can even reduce the yields from those obtained with proper seeding rates.

Under dryland conditions the seeding rate for barley should range between 1 and 1½ bu/A (53.8 to 80.7 kg/ha), with 1¼ bu (67.2 kg) the preferred rate. On irrigated land, ¾ to 1¼ bu/A (40.3 to 67.2 kg/ha) is sufficient.

A seeding rate of 1¼ to a maximum of 1¾ bu/A (67.2 to 94.1 kg/ha) should be used when the seed

is broadcast; this method can be justified only on small acreages.

The precise rate of seeding will depend upon several factors — time of seeding, soil type, soil fertility, and annual rainfall. Consequently, a precise recommendation for rate of seeding is not feasible.

Barley is usually seeded at a depth of 1½ to 2 inches (3.8 to 5.1 cm). However, the coleoptile will elongate to the soil surface from 3- or 3½-inch depths (7.6 to 8.1 cm) if it is necessary to place the seeds in contact with moisture. Seeds will emerge from greater depths in sandy soil than in clay soil and in warm soil than in cold soil.

Use Good Seed

Good quality seed of recommended varieties is usually available from the originating experiment station, seed dealers, or members of the Crop Improvement Association. The grower should plant only seed that is true to variety, free of disease and weed seeds, and has good kernel weight and high germination. Registered and certified seed must meet certain standards of quality and purity, assuring purchasers of obtaining high quality seed of a known variety.

Good seed of most adapted varieties can be grown for several years if care is taken to prevent admixtures and contamination with weed seeds or disease organisms. If the seed does become contaminated or infected, the grower should dispose of the grain and buy certified seed of the same variety or another adapted variety.

Irrigating Barley

Barley is a good crop to grow under irrigation.

It has a short growing season. This permits either 1) double cropping with an early maturing barley variety, or 2) use of a movable irrigation machine on barley and then on corn. With good cultural practices, high levels of production can be realized.

A good operator can expect yields of 100-125 bu/A (53.8 to 67.2 q/ha) with 50- to 52-lb bushel weights (64.4 to 67.0 kg/hl). Both two-row and six-row varieties produce high yields under irrigation.

For further information see Fact Sheet 747, "Irrigating Barley in South Dakota."

Weed Control

Weeds compete with barley for light, moisture, and soil nutrients. This competition reduces yields and lowers the quality of the grain.

A good weed control program includes both proper cultural practices and herbicide applications throughout the rotation. Cultural control includes 1) using weed-free seed, 2) cultivating row crops which precede barley, 3) summer tillage of grain stubble, and 4) carrying out other practices which prevent weed seed production. For recommendations on weed control in barley see the Fact Sheet 525A "Chemical Weed Control in Small Grains and Forages."

Disease Control

Most of the common barley diseases are found in South Dakota fields every year. The level of infection for any of the diseases varies from year to year and from one area to another.

These diseases usually do not cause a noticeable reduction in yield and grain quality. Very seldom does one disease become severe enough to cause serious crop loss.

When a particular disease becomes a problem, two options are available to the grower. He can sell all of his harvested and stored barley and purchase clean certified seed of that variety or buy certified seed of a different variety that has better disease resistance.

Diseases in barley are caused by bacteria, fungi, and viruses. They are either carried in the seed from one crop to the next or infect the growing plants each year.

The most common barley diseases in the north-central United States are net blotch, spot blotch, Septoria, leaf rust, and loose smut. Two other diseases, scab and bacterial leaf stripe, also appear in fields. Chemical control of barley diseases is limited.

Vitavax has been an effective agent for the control of loose smut.[1] Treatment of the seed with this product at the rate of 2 ounces per hundredweight (1.2g/1 kg) kills the fungus infecting the barley kernels. Numerous experiments have demonstrated that yield loss from loose smut does not occur until more than 5% of the plants in the field are infected.

The amount of new crop seed which becomes infected with smut will depend on weather conditions at heading time. Warm, dry weather at heading will cause a reduction in infection from windblown spores. Cool, wet weather at heading will usually cause an increase in infection. A grower with a high level of infection should treat the seed or sell all grain of that variety.

Zinc ion-maneb complex (tradenames Dithane M45, Manzate 200, Fore and Macozan) controls leaf diseases of barley plants. If plants become heavily infected with spot blotch, net blotch, leaf rust, or another fungus, the grower should spray as soon as possible. Control will be achieved with one of the commercial products if applied at the rate of 2 lb of product per acre (2.2 kg/ha).

[1] Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture and does not imply its approval to the exclusion of other products that may also be suitable.

Good management requires attention to disease control if high yields are to be achieved.

Good cultural and management practices are important factors in reducing losses to disease. One example of a good management practice is to fall plow corn stubble and reduce scab infection in a following barley crop. Practices which promote good plant growth and reduce losses to disease are maintenance of adequate soil fertility, proper preparation of the seedbed, use of high quality seed, early seeding, and weed control.

Harvesting and Storing

The procedures used in harvesting and storing barley greatly influence the grain quality and market value of this crop.

Most barley is windrowed because weeds, uneven ripening, shattering, or excess grain moisture prevent direct combining.

Operation of the combine and adjustment for proper threshing are essential to the handling of grain which will command the market premium. These points for operating and threshing properly should be kept in mind.

Operation of Combine

(1) Forward speed of combine should be varied to keep the combine at capacity load. This can be accomplished by reducing speed through a heavy windrow and increasing it through a light one. The cushioning effect of straw reduces the number of skinned and broken kernels.

(2) Keep the machine aligned so the windrow feeds into the center of the cylinder.

(3) Adjust the machine for changes in air temperature or moisture content of the straw and grain as the day progresses.

Proper Threshing

(1) Set cylinder speed so grains are just removed from heads. This is accomplished at somewhat slower speed for barley than for wheat. Cylinder speed for two-row barley should be lower than for six-row barley.

(2) Adjust concave clearance to match cylinder speed because close concave settings require slower cylinder speeds than do wide settings.

(3) Adjust wind volume and sieve settings to obtain good separation of grain from the chaff and straw without loss of grain.

(4) Operate so the amount of grain coming back through the returns is held to a minimum.

(5) Operate blower elevator at proper speed.

All combines have operator's manuals. They will give specific instructions for adjusting the machine for harvesting barley. Adherence to the instructions is important in obtaining high quality grain with a minimum of skinned and broken kernels.

Storing

Barley should be threshed at the proper time. It can then be stored without additional drying or other treatment to maintain its quality.

The keeping of grain depends largely upon its condition when placed in storage. Threshed grain is usually stored in comparatively tight bins that allow little moisture to escape. Binned grain that contains more than 13 to 14% moisture is likely to deteriorate. Excessive moisture promotes heating, generated by molds and bacteria which grow and eventually destroy the stored product. The storage bin should be free of grain weevils and other insect pests.

Insects, bacteria, and molds all respire and release heat, moisture, and carbon dioxide, accelerating the heating of grain. Grain which becomes overheated loses its viability and will not germinate. The dead grain in its musty state and fouled condition is unfit for use in malting or as a livestock feed.

Variety Selection

Numerous yield trials have been conducted by South Dakota Experiment Station personnel during the past 20 years. They show that smooth awned varieties out-yield rough awned varieties at most test locations a majority of the time in this state.

This is especially true in those years when barley plants are subjected to high day and/or night temperatures and soil moisture stress after heading. The extensive acreages and good production records of the smooth awned varieties Conquest, Larker, Prilar, Primus, and Primus II confirm this judgment.

Selecting the best barley variety for a farm or for a certain field is an important decision. Growing an adapted variety or varieties helps to insure more stable production. Ignoring this principle often results in production losses and fluctuations in farm income. The recommendations and variety descriptions given in this bulletin should help growers choose a variety.

The barley varieties listed in Table 1 represent a range in earliness, disease and insect resistance, grain quality, and market needs. The first four varieties are smooth awned and will usually perform better under drought and high temperature stress.

The table gives the important characteristics of the varieties being grown in the state. Variety recommendations according to "crop adaptation areas" are given in each current year's Fact Sheet 524, "Crop Variety Recommendations."

Table 1. Varieties which perform well in South Dakota.

Variety	Yield	Plant height	Maturity	Lodging resistance	Bushel weight	Seed size	Malting	Aleurone color	Disease reaction[3] Stem rust	Spot blotch	Loose smut
Primus II[1]	High	Medium	Early	Very good	Medium	Medium	No	White	R	S	S
Prilar	High	Medium	Medium	Good	Medium	Medium	No	White	R	S	S
Larker	High	Medium	Medium	Good	Medium	Medium	Yes	White	R	S	S
Morex	High	Medium	Medium	Good	Medium	Medium	Yes	White	R	MR	S
Glenn	High	Medium	Medium	Good	Medium	Medium	No	White	R	MR	R
Beacon	High	Medium	Medium	Good	Medium	Medium	Yes	White	R	MR	S
Firlbecks III[1,2]	High	Medium	Late	Good	High	Large	Yes	White	S	S	S

[1] Firlbecks III recommended only for irrigation west of the Missouri River. Primus II for both dryland and irrigated cultivation.
[2] Two-row variety.
[3] All varieties are susceptible to leaf rust and yellow dwarf. R = resistant; MR = moderately resistant; S = susceptible.

Classes of Barley

Malting Barley

Historically most of the malting barley has been grown in the northeastern counties where growing conditions are more favorable for the production of good quality grain. This was especially true until newer, smooth awned varieties came into production in the 1960's.

These varieties and improved management practices have substantially increased the chances for producing good malting barley anywhere in the eastern part of the state.

The malting process (which involves germinating the grain) results in the conversion of water-insoluble starch to maltose sugar, hence the words malting and malt. About 130 million bu (45,810,135 hl) of barley are used annually in the United States for producing malt. About 85% of the malt is used in making beer, 10% for making industrial alcohol and whiskey, and the remainder for malt syrups.

The market price differential between malting and feed barley is a premium that varies from year to year but often is substantial.

If you are a grower in eastern South Dakota, consider raising barley for this cash premium. The amount of barley used in the production of malt increases by about 4% annually, so there is an increasing need for malting barley. South Dakota barley has been in demand, and the malting industry indicates that this demand will continue.

A malting variety is a barley selection that has been tested in plant-scale tests of 10,000- or 20,000-bu lots (3,524 or 7,048 hl) and then approved by the malting and brewing industry after release as a variety. Such varieties possess the physical and chemical grain characteristics considered essential for economical processing into malt. However, growing an approved and recommended variety does not guarantee that malting quality and a cash premium will be obtained. Seasonal growing conditions and cultural practices greatly affect crop yield and quality.

Accepted varieties possess certain inherited characteristics which influence quality and are necessary for inclusion in the malting class: (1) bright, plump kernels with a firm, thin hull; (2) lower protein content; (3) a mellow, starchy endosperm; (4) high level of enzyme activity; (5) high malt extract; and (6) white aleurone layer (pearl white).

Barley must meet certain requirements, according to the U.S. Grain Standards, to be classified as having malting quality:

1. 90% or more of the kernels with white aleurone layers
2. not more than 5% unsuitable malting types or varieties
3. not more than 4% damaged kernels
4. not over 3% foreign material
5. not more than 8% skinned and broken kernels
6. not more than 15% thin barley
7. not more than 2% black barley
8. not more than 5% other grains
9. a minimum test weight of 43 lb/bu (55.4 kg/hl)
10. a minimum of 90% sound barley.

In addition, malting barley should not be over 13.5% protein, and moisture content should not exceed 13%. Germination should be better than 90% with 95-100% germination preferred.

Following are cultural practices suggested for malting barley growers:

1. Plant early. Research data have shown that barley planted 2 weeks later than the average planting date (April 15) resulted in slightly over 2% increase in the protein content of the grain. Yields were higher with lower percent of thin kernels for the average planting date.

2. Apply commercial fertilizer according to recommendations but avoid excessive use of nitrogen.

3. Thresh carefully. Adjustment of combine is important in preventing skinned and broken kernels. Damaged kernels will not germinate normally and thus are not suitable for malting.

4. Harvest barley when mature.

5. Plant pure and high quality seed of the

recommended malting varieties. Use certified seed to insure varietal purity.

6. Store barley that contains less than 13.5% moisture. High moisture barley will heat, mold, drop in germination percentage, and be worthless for malting.

Feed Barley

The feed barley class includes (1) varieties whose grain does not possess the chemical characteristics required by the malting and brewing industry for economic production of malt and beer, and (2) grain of malting varieties which fails to meet one or more of the 10 requirements listed for malting classification because of growing conditions or improper handling.

About 70% of the barley produced in the United States is used as a feed grain. All barley varieties, including those recommended for malting, are excellent feeds for all classes of livestock. Barley is a good feed for growing animals. For fattening purposes it compares favorably with corn. Barley has more digestible nutrients than oats and slightly less than corn.

The digestibility of barley is increased appreciably by rolling or soaking. In some feeding trials with cattle the feed efficiency of a barley based ration has exceeded that of the corn based ration. Barley is higher in fiber and protein than corn, so less roughage and protein supplement are needed with it than with corn. The value of barley in relation to corn depends partly on the prices of roughages and protein supplements. For hogs barley should be fed ground or as a pellet.

Breeding work is underway to improve the nutritional quality of barley. This grain now has lower total energy (less oil) than corn and poorer protein quality (less desirable amino acid balance) than oats. Sometime in the future, barley varieties with better feed quality will be available to the livestock feeders, and barley will compete more effectively with other feed grains in the feedlot.

Services Available

The South Dakota Experiment Station will assist you in growing barley. Several services are available which can provide assurance that you are planting good quality seed on soils of acceptable fertility. We encourage you to use these services. Testing services do have a reasonable charge.

Soil Testing

Soil samples can be sent to State Soil Testing Laboratory, Plant Science Department, SDSU, Brookings, SD 57007. County Extension agents have forms and instructions for taking soil samples.

Seed Testing

Use of good quality seed with high germination rate is the first step to a high yielding barley crop. State law requires labeling of all barley seed advertised and sold for seed. Purity and germination tests of all samples and tests of all samples suspected to contain noxious weed seeds are recommended.

Send one quart (1.1 1) of seed to State Seed Testing Laboratory, Plant Science Department, SDSU, Brookings, SD 57007.

Loose Smut Test

The level of loose smut infection in barley seed can vary considerably from year to year. Any grain which contains 5% or more loose smut should not be used for seed.

To determine the level of infection send a 1-lb (454 gm) sample of barley to Plant Disease Clinic, Plant Science Building, SDSU, Brookings, SD 57007.

Certified Seed Directory

Write to the Seed Certification Service, Plant Science Department, SDSU, Brookings, SD 57007, for a free copy of the directory of certified seed growers in South Dakota.

The directory contains names and addresses of growers of several standard barley varieties. If you do not see a variety listed that you want, the Seed Certification Service will help you locate a seed source.

Planting certified seed assures growers that they are using seed of a known variety and that the seed has met certain minimum standards of genetic purity, mechanical purity, and germination. Good seed does not cost, it pays.

Published in accordance with an Act passed in 1881 by the 14th Legislative Assembly, Dakota Territory, establishing the Dakota Agriculture College and with the Act of re-organization passed in 1887 by the 17th Legislative Assembly, which established the Agricultural Experiment Station at South Dakota State University.

File: 1.4-2.2—5,000 printed at estimated 13 cents each—10-79mb—4702A.