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Producing Malting Barley In Idaho

Idaho is an important production area for two-row malting barley and for a smaller but important amount of six-row malting barley. A good market exists for malting barley today and demand is expected to remain strong and increase in the future. U.S. consumption of malt increased at an average rate of about 3% annually during the period 1960-75, exceeding 124 million bushels in 1975. About 1 bushel of barley (48 lb.) is required to produce 1 bushel of malt (34 lb.).

Malting varieties were grown on about 478,000 acres in Idaho in 1977, or just over half of the state barley acreage. An estimated 10 million bushels of malting barley produced in 1977 were marketed from Idaho.

Until recent years, malting barley was produced primarily on dryland in the Palouse and the Camas Prairie of northern Idaho. These two areas remain important, but irrigated acreages in southern Idaho now exceed the acreage grown in northern Idaho. The irrigated acreages of southern Idaho produce some of the finest quality malting barley in the United States. Limited quantities of satisfactory malting barley are sometimes produced on dryland in southern Idaho but protein content of dryland barley often exceeds the maximum allowable for malting barley.

Malting and Quality Requirements

To produce malting barley that meets maltsters' requirements, growers must plant the proper variety and apply management practices that result in plump, high-quality seed with germination as near 100% as possible.

Malting barley must be delivered in pure lots free of mixtures of other barley varieties, other grains, wild oats and foreign material. It must be sound, bright, plump, low-moisture barley within a specific protein range and free from other damage. It should be fully ripened with plump kernels of uniform size so that it will have uniform, vigorous and high germination. It should have a minimum of skinned and broken kernels and should not contain barley that has been damaged by frost, heat or mold. Barley that is stained, bleached or contaminated with garlic, weevils or ergot is also unacceptable.

Varieties

The Malting Barley Improvement Association (MBIA) recommends specific varieties of barley as acceptable for malting and brewing. Malting barleys listed for Idaho for 1978 are the two-row varieties Kimberly, Klages, Moravian III, Piroline and Vanguard and the six-row varieties Blazer, Karl and Larker. **Since a specific malting barley variety may be preferred in certain markets, growers may wish to consider differences in market demand among approved varieties before planting, especially if the barley is not under contract**. Barley acceptable for malting will usually command premium prices over feed barley.

Varieties acceptable for malting and brewing are also acceptable as feed barleys. Growers and feeders often report a preference for malting barley varieties because they typically produce attractive, plump grain with good test weight.

Table 1. Agronomic data from two-row spring malting barleys trials, 1973-77.

Variety	Average yield	Test weight	Kernel weight	Plump	Heading date[1]	Height[2]	Lodging[3]
	(bu/acre)	(lb./bu)	(g/1000)	(%)		(in)	(%)
Aberdeen — irrigated (1973-77)							
Kimberly	119.5	53.0	45.1	90	7/2	32	10
Klages	116.6	53.5	44.4	90	6/30	32	12
Moravian III	103.8	54.8	43.9	97	6/26	31	16
Piroline	108.6	54.0	42.8	96	6/25	31	16
Twin Falls — irrigated (1973-75, 1977)							
Kimberly	124.1	53.9	43.1	90	—	31	—
Klages	122.3	54.1	43.6	92	—	31	—
Moravian III	110.8	55.4	43.3	96	—	33	—
Piroline	109.1	54.4	42.4	94	—	32	—
Tetonia — irrigated (1973-74, 1976)							
Kimberly	91.4	53.2	44.7	93	7/29	—	—
Klages	83.3	53.6	45.6	95	7/27	—	—
Moravian III	79.7	54.5	43.0	98	7/24	—	—
Piroline	82.4	53.5	42.5	97	7/21	—	—
Bonners Ferry — dryland (1975-77)							
Kimberly	62.4	48.8	—	93	—	29	—
Klages	61.8	48.2	—	93	—	30	—
Vanguard	67.4	50.7	—	92	—	27	—
Grangeville — dryland (1976-77)							
Kimberly	66.0	54.3	—	96	—	—	—
Klages	61.3	53.8	—	98	—	—	—
Vanguard	64.4	53.9	—	96	—	—	—
Moscow — dryland (1975-76)							
Kimberly	80.5	53.1	—	95	7/17	26	—
Klages	72.1	52.8	—	95	7/16	27	—
Vanguard	73.6	52.1	—	93	7/15	25	—

[1]Data for Tetonia in 1973 and 1976; for Moscow in 1976.
[2]Data for Twin Falls in 1974-75; for Bonners Ferry in 1975 and 1977.
[3]Data in 1973 and 1975-76.

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Table 2. Agronomic data for six-row spring malting barleys and selected checks, 1973-77.

Variety	Average yield	Test weight	Kernel weight	Plump	Heading date[1]	Height[2]	Lodging[3]
	(bu/acre)	(lb./bu)	(g/1000)	(%)		(in)	(%)
Aberdeen (1973-77)							
Karl	109.0	53.6	40.5	92	6/22	30	10
Larker	101.1	52.7	40.1	96	6/25	35	15
Klages	118.3	54.0	47.7	93	6/29	32	12
Steptoe	138.1	51.0	48.8	96	6/22	31	15
Twin Falls (1973-75, 1977)							
Karl	110.7	53.6	42.0	92	—	35	—
Larker	100.9	52.3	38.1	92	—	39	—
Klages	119.0	55.0	45.3	93	—	33	—
Steptoe	130.4	51.2	49.7	95	—	36	—
Bonners Ferry (1975-77)							
Larker	64.3	47.2	—	95	—	32	—
Vanguard	67.4	50.7	—	92	—	27	—
Steptoe	79.1	46.3	—	97	—	28	—
Grangeville (1976-77)							
Larker	61.4	52.5	—	95	—	—	—
Vanguard	64.4	53.9	—	96	—	—	—
Steptoe	84.9	51.4	—	98	—	—	—
Moscow (1975-76)							
Larker	64.0	52.3	—	92	7/13	29	—
Vanguard	73.6	52.1	—	93	7/15	25	—
Steptoe	82.0	49.4	—	95	7/12	25	—

[1]Heading date data for Moscow in 1976.
[2]Height data for Twin Falls in 1974-75; for Bonners Ferry in 1976.
[3]Lodging data in 1973 and 1975-76.

Table 3. Nitrogen fertilizer rates for irrigated malting barley based on previous crop.

Previous crop	Nitrogen
	(lb N/acre)
Grain or corn (residue returned)	80-120*
Grain or corn (residue removed)	80
Sugarbeets or potatoes	0-40**
Beans, peas	20
Alfalfa, green manures (legumes)	0

*Apply 120 lb N only if heavy residue is returned to the soil. 80 lb N is usually adequate when only a light grain or corn residue is returned.
**Depends on nitrogen carry-over; a soil test is recommended.

Agronomic data for two-row varieties are summarized in Table 1; six-row varieties in Table 2. In trials where comparisons are possible, the six-row barley variety — not a malting barley — averaged higher in yield than the two-row malting varieties. Steptoe yields under irrigation during the period 1974-1977 ranged from 101.9% of Klages at Tetonia (1974, 1976) to 105.2% of Klages at Twin Falls (1974-75, 1977) and 112.9% of Klages at Aberdeen (1974-77). In dryland trials (Table 2), Steptoe exceeded the best yielding two-row malting variety in yield by 17.4% at Bonners Ferry, 1.9% at Moscow and 28.6% at Grangeville. Additional information on these and other barley varieties is included in University of Idaho publications available from all County Extension Agricultural Agents in Idaho. Information on varieties recently released or of special interest, and others not appearing in the agronomic tables, follows:

KIMBERLY Kimberly was developed cooperatively by the Agricultural Research Service, USDA, and the Idaho Agricultural Experiment Station and released in the spring of 1978. It was classified as acceptable for malting and brewing by the MBIA in November 1977. Kimberly, which was tested as 71Ab4552, is similar to Klages in agronomic characteristics. It averaged 3.8% higher yield than Klages in 26 irrigated trials at Aberdeen, Twin Falls, Tetonia and Rexburg from 1972-77. The yield advantage at Aberdeen and Twin Falls was 2.5 and 3.6% respectively; however, Kimberly averaged 9.7% higher yield than Klages in 3 years of irrigated testing at Tetonia. In southern Idaho irrigated trials, it has been similar to Klages in test weight, plump barley percentage, height and lodging. It heads 1 or 2 days later than Klages at Tetonia and an average of 2½ days later at Aberdeen. In regional trials throughout the West, Kimberly averaged about 3 days later than Klages in heading date in 1975-76.

Kimberly has not been tested extensively in dryland trials in southern Idaho but available data suggest it will be similar to Klages in agronomic performance. Although Klages is not recommended for dryland production in low rainfall areas, a few growers have produced satisfactory crops on certain dryland sites in southern Idaho. In dryland trials at Tetonia in 1976-77, Kimberly averaged 62.9 bushels per acre or about 5% higher than Klages in yield. The two varieties were similar in test weight, plump barley percentage and kernel weight.

Kimberly yielded higher than Klages in dryland trials in the Palouse and Camas Prairie areas of northern Idaho. In trials near Nezperce in 1975-76, Kimberly averaged 6.3% more than Klages in yield and equaled Steptoe. In four trials at Moscow and Grangeville in 1975-77, Kimberly averaged 9.7% higher than Klages in yield, 6.1% higher than Vanguard and about 12% less than Steptoe.

MORAVIAN III Moravian III is a two-row variety recently introduced as a replacement for Moravian. Although it has averaged lower yield than Klages in irrigated trials at Aberdeen, Twin Falls and Tetonia, Moravian III typically exceeds other two-row malting varieties in kernel plumpness. Data from a limited number of trials indicate that, under moisture stress, Moravian III is likely to perform better than Klages, especially with respect to kernel plumpness.

KARL Most spring six-row malting varieties have originated in the Midwest or Canada. Exceptions are Karl and Blazer. Although many Idaho growers have found that these varieties perform well, they have not gained as wide an acceptance as some of the well-adapted six-row feed barleys. Plant breeding programs are now placing more emphasis on the development of better adapted six-row malting barleys for growers in Idaho and the Northwest.

irrigations to minimize early vegetative development and hence minimize water requirements at the critical period following heading. Over-irrigation late in the season after the crop is essentially mature will lower grain quality.

Harvesting

Properly threshed malting barley will contain less than 5% skinned and broken kernels and will have short pieces of beard attached to the kernels. Contract specifications for skinned and broken kernels may vary slightly depending on the firm involved or the variety under contract. Skinned kernels are defined as kernels with the hull loosened or removed over the germ, or with one-third or more of the hull skinned off. Malting barley with small pieces of beard attached is preferred even though that contributes to lower test weight. Closely threshed, high test-weight barley may be desired in some feed barley markets, but close threshing that results in excessive skinned and broken kernels will mean loss of a premium market for otherwise good quality malting barley. The percentage of plump kernels over a 6/64 x 3/4-inch screen is a much more important measure of grain quality for malting than test weight.

High cylinder speed is primarily responsible for skinned and broken kernels. Each operator should consult a fieldman or owner's manual to determine correct cylinder speed adjustment. Cylinder speed recommendations in owner's manuals may apply primarily to Midwest six-row barley and result in excessive skinned and broken western two-row or six-row barley. In general, cylinder speeds for threshing wheat are too high for malting barley. Cylinder speeds from 450 to 700 rpm have been satisfactory for malting barley in southern Idaho. Start with 450 to 500 rpm and make further adjustments as indicated by the appearance of the threshed barley. Minor adjustments may also be necessary to compensate for changes in temperature or moisture content of the straw and grain.

Most malting barley varieties can be easily harvested with acceptable levels of skinned and broken kernels. Varieties vary in ease of threshing and resistance to mechanical damage, so different varieties may require different combine adjustments. Because of its relatively thin hull, Karl is more easily skinned than other varieties.

Storage

Malting barley is a food product. It must meet standards established by the Food and Drug Administration for grain used for human consumption. Grain in interstate commerce that fails to meet standards of wholesomeness because of infestation or contamination is subject to seizure or reduction in grade and substantial financial loss.

Insects, storage fungi, rodent or bird excreta and admixtures of treated grain are among the most common sources of infestation or contamination of malting barley. Do not permit contamination of malting barley or any food or feed grain with fungicide-treated seed. Clean combines, trucks and grain augers thoroughly before harvest to help eliminate sources of insect infestation. Eliminate spilled grain, weeds and trash in the vicinity of storage facilities to aid in insect and rodent control.

Clean storage bins thoroughly. Apply a spray to empty bins if insect infestation is suspected. Methoxychlor and malathion are insecticides currently suggested as empty bin sprays. Grain protectants or fumigants are available for supplemental use when serious insect infestations occur in storage. Exercise caution in the use of all pesticides. Read the label before using. Follow all state and federal regulations and label instructions concerning bin sprays, seed protectants and fumigants to avoid health risks to applicators or illegal residues. Pesticides are not a substitute for good bin sanitation.

Construct or modify storages to exclude moisture, rodents and birds. Properly stored malting barley that is clean, relatively free of skinned and broken kernels and with moisture content below 13% is unlikely to deteriorate because of insects or storage fungi. Inspect bins periodically for insects, molds and heating. Early detection of storage problems will permit prompt and effective remedial action. Most ASCS offices have long grain probes available for sampling bins. Field experience indicates that moisture problems occur most frequently in storages with capacities over 4,000 bushels. In larger capacity storages, properly installed aeration equipment will help to minimize moisture problems. High moisture and insect infestation in long-term storage is usually evident first in the peak or crown of a bin. Consult a fieldman or County Extension Agent for help with specific storage problems.

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Most of the Karl grown commercially in southern Idaho has been swathed to minimize shattering losses. Essentially all of the Karl acreage in Idaho is irrigated. The variety is not recommended for dryland production.

BLAZER Blazer is a six-row barley variety developed at Washington State University and released in 1974. Blazer has been listed as an acceptable malting barley variety in Washington and Idaho since 1976. It is well adapted to the Palouse area of eastern Washington and adjoining areas of northern Idaho. Blazer is superior to both Karl and Larker in resistance to shattering. Its yields under irrigation have averaged 6.7% higher than Karl in 5 station-years (1975-77) of testing at Aberdeen and Twin Falls. In these trials it averaged 8% less than Karl in plump barley percentage and 2 pounds per bushel lower in test weight. Blazer heads about 5 days later than Karl at Aberdeen. It averaged from 3 to 8 inches taller than Karl in the same irrigated trials.

Contract Production

A large percentage of malting barley produced in Idaho is grown under contract. Contracting is often advantageous to growers although, in recent years, there has also been a good market for malting barley not grown under contract. Contracts may guarantee the grower a minimum price per hundredweight of acceptable barley, or may quote a premium price per hundredweight over feed barley prices, based on major West Coast market prices for feed barley, minus freight. Contract terms vary with the firms involved and change from year to year, but contracts serve to make malting barley an attractive cash crop for many Idaho growers. Several firms contract malting barley in Idaho. Interested growers should contact representatives of these firms for more details.

Diseases

Three species of barley smut occur in Idaho — loose (*Ustilago nuda*), covered (*U. hordei*) and semiloose (*U. nigra*). Loose and covered smut are the most common diseases. Most barley varieties currently grown in Idaho are susceptible.

Loose smut is first noticeable just after heading as a loose, black, spore mass which has replaced the entire kernel structure including the awns. The spores are disseminated by wind, leaving only the bare rachis when the crop is mature. Infection occurs at flowering. **Covered smut** first appears about heading time as a firm, black spore mass covered with a grayish membrane. The spore mass replaces the kernels although the awns and parts of the hull are not completely destroyed. The spores tend to remain as an intact mass until harvest. During the growing season and at harvest, the spore masses are ruptured and the potentially infective spores adhere to barley kernels.

Loose smut is a disease carried within the kernel; semiloose and covered smut spores are contaminants on the outside of the seed. All these smuts are seed-borne so only seed infected with the smut organism or seed infested with spores will produce smutted plants. The percentage of smutted plants within a field will not increase during the crop year. Yield losses due to smut are about equivalent to smutted plants.

Loose and covered smut can be effectively controlled by seed treatment with Vitavax*. Vitavax-treated Foundation or Registered seed should be produced in isolated fields to keep it free of loose and covered smut. Planting Certified seed from Vitavax-treated Registered seed reduces the risk of loose smut.

Ergot, a fungus disease that attacks barley and other cereals, has been observed occasionally in Idaho barley. Because ergot is poisonous to humans and livestock, any grain containing more than 0.3% ergot by weight is graded "ergoty" and is discounted. You can maximize ergot by removing nearby wild grasses before flowering of the barley by crop rotation and by using ergot-free seed. No varieties are resistant, so ergot infestations are possible in all varieties.

Late seeding of spring varieties increases the risk of infection by barley yellow dwarf virus and root, crown and foot rots. Each of these diseases reduces grain yield and quality.

Certain irrigated Klages fields were severely infected in 1977 by a bacterial blight that attacked barley kernels as well as leaves. Preliminary findings suggest that a secondary invasion of Alternaria spp. along with bacterial blight were causal factors that resulted in a dark lesion of discoloration on the dorsal surface of some kernels. This discoloration is apparently the principal effect of the disease since most affected kernels are normal in size. The disease had been observed in other years and in other varieties, but the most severe infections were found in 1977 in certain Klages fields. The disease is currently the subject of cooperative studies.

Bacterial leaf blight has been reported to be present wherever barley is grown. It is usually of minor importance but occasionally severe losses occur. Crop rotation may help control the disease. Although some varieties are resistant to bacteria, published literature suggests that the degree of resistance is associated more with stage of development and condition of plants at the time of infection than with the particular variety. Insects may be involved in the transmission of the disease along with wind and rain and physical contact between plants.

In addition to crop rotation, maintaining an environment less favorable for the bacteria may be helpful. Growers should avoid over-irrigating. Relatively lush vegetative development is also thought to favor the disease. Such conditions may be minimized by reducing seeding rates, wider row spacing (up to 12 or 14 inches between rows), application of nitrogen fertilizer not to exceed recommended levels and by avoiding excessive early irrigation.

Time of Planting

Early spring seeding whenever soil conditions permit is desirable for all barleys so that the plants develop during the cooler part of the growing season. Barley performs best when heading and kernel filling take place while temperatures are moderate and soil moisture adequate. Early planting will generally assure a minimum of moisture and temperature stress on the plant following heading. This will allow for maximum deposit of starch in the kernels and produce the plump, full-bodied and mellow kernels that are desirable for malting barley.

*Vitavax is the tradename of Uniroyal, Inc. for 75% 2,3-dihydro--carboxanilido-6-methyl-1, 4-oxathiin.

Seeding Rate

Seeding rates satisfactory for feed barley are also satisfactory for malting barleys. Seeding rates of 80 to 100 pounds per acre are common under irrigation in the Upper Snake River Valley. Farmers in the Magic Valley generally seed 100 pounds per acre under irrigation, while growers in the Boise Valley often use rates of 125 pounds or more. Seeding rates on dryland typically vary from 30 to 70 pounds per acre. Modest increases (10 to 25 pounds) over normal seeding rates have reportedly been beneficial in late plantings.

Only limited studies concerning seeding rates have been conducted in recent years. In dryland trials at Tetonia in 1968-70, the two-row variety Piroline averaged 49.0 bushels per acre at the 30-pounds-per-acre rate, 48.3 at the 50-pound rate and slightly lower in yield at 70 and 90 pounds per acre seeding rates. Other varieties exhibited a similar response in these dryland trials. In 3 irrigated trials at Aberdeen in 1975-76, seeding rates of 70, 90 and 110 pounds per acre produced similar yields of two-row barley with a small overall, but inconsistent, yield advantage for the 110-pound rate. Irrigated yields were lower at the 30- and 50-pound seeding rates.

Protein Content and Fertilization

Protein content is important to the maltster and brewer. High protein is objectionable. Problems associated with high protein include uneven water uptake and germination during malting; increased malting losses due to abnormal growth during malting; reduced mellowness of the malt; excessive enzymatic activity; low extract yields; excessive concentrations of nitrogenous compounds in the wort, and chill-haze problems with the finished beer. Maltsters prefer two-row barley having a protein content ranging from 10 to 12% with 12.5% acceptable. They prefer six-row barley at 11.5 to 13% protein, with 13.5% acceptable.

The total amount of nitrogen available for plant growth and the yield and protein content of the grain are directly related. If nitrogen fertilizer is available in excess of that required for maximum yields, the grain usually has undesirably high protein content. Excess nitrogen also leads to lodging, shriveled kernels, increased vegetative development and delayed maturity. Delayed maturity and excessive vegetative development may increase water use.

Data from the USDA Barley and Malt Laboratory, Madison, WI, indicate that two-row malting barley varieties are similar in protein content when grown in Idaho under the same experimental conditions. Karl, however, typically averages lower in protein content than other six-row varieties. In 3 irrigated trials at Aberdeen and Twin Falls in 1972-73, Karl averaged 11.1% protein over 3 nitrogen levels compared with 13.4% for Traill and 14.1% for Larker. At Aberdeen in 1974-76, Karl averaged 11.5% protein and Larker averaged 14.7%. The advantage of Karl is that satisfactory protein content can be obtained in environments where protein levels of other varieties tend to be too high. This advantage carries with it the risk of undesirably low protein content that results in low enzymatic activity in the malt. Karl growers with a history of relatively low protein content may, therefore, wish to consider slightly higher nitrogen levels. Use a soil test to avoid excessively high nitrogen levels that could result in increased lodging.

Table 3 is a guide to nitrogen fertilization based on the previous crop. Field experience has shown that in many cases no supplemental nitrogen is required following potatoes and sugarbeets. More complete information on fertilization practices, including nitrogen application rates based on soil tests, is included in *Idaho Fertilizer Guide, Malting Barley*, UI Current Information Series No. 270, available from County Extension offices.

Studies conducted by B. J. Ruffing and others at the USDA Snake River Conservation Research Center, Kimberly, ID, indicate that maximum yields of good quality malting barley can be obtained on Portneuf soil if no more than 110 to 125 pounds per acre of residual and applied nitrogen are available in the top 24 inches. A commercial soil test of the top 2 feet for nitrate-nitrogen will help growers determine optimum rates of nitrogen application.

Additional information is available in *Managing Irrigation and Nitrogen for Moravian Barley in Southern Idaho*, UI Current Information Series No. 365, available from County Extension offices. Although the research reported in that publication involved only Moravian and Moravian III barley, the results are applicable to all malting barley.

Irrigation

Growers should check soil moisture at the 6- to 12-inch depth to determine when the first irrigation is needed. The first irrigation should not be applied until available soil moisture in the root zone has declined to about 40%. The first irrigation should be light, wetting down to the sub-moisture or approximately 12 inches. Excessive early irrigation will leach nitrogen beyond the root zone and consequently reduce yields.

A second irrigation should be applied as necessary, probably between boot and heading. This will vary depending upon the water-holding capacity of the soil. At this stage of development, plant growth is almost at a maximum and a fairly high level of soil moisture should be maintained. During the critical period from late boot to soft dough, soil moisture should be maintained at the 40% level or above at 12-inch depth.

Some growers have used 24-hour sets to advantage. Longer sets may tend to even out wind skips and result in more reserve moisture lower in the soil profile. However, 24-hour sets are generally not recommended for the first irrigation. If lodging is a problem, shorter sets may be required in subsequent irrigations as well.

Further irrigation will probably not be required on medium-textured soils if soil moisture is at field capacity when the grain is in the soft- to stiff-dough stage. At stiff-dough, the grain has reached full physiological maturity. Four irrigations are generally adequate on medium-textured soils if rainfall and air temperatures are normal.

Growers frequently over-irrigate late in the season, resulting in thin barley with high protein content. If water is likely to be limited late in the season, manage earlier