Barley A Rediscovered Michigan Feed Grain

Michigan State University Extension Service
R.H. Leep, L.O. Copeland and R.D. Freed Crop and Soil Sciences; H.F. Bucholtz, Animal Science

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PRODUCTION PRACTICES FOR MICHIGAN CROPS

B·A·R·L·E·Y

A REDISCOVERED MICHIGAN FEED GRAIN

R.H. Leep, L.O. Copeland and R.D. Freed
Department of Crop and Soil Sciences
H.F. Bucholtz
Department of Animal Science
Cooperative Extension Service
Michigan State University

Barley has become increasingly attractive to many Michigan farmers as an alternative feed crop for livestock, especially dairy and beef cattle. It is equally well adapted to the growing season in northern Michigan, where corn grain production is often marginal, and to the best areas of southern Michigan. Although production costs are low, barley responds well to good management. It is also an excellent concentrate in livestock rations and can have a high cash value.

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ROLES OF BARLEY IN MICHIGAN

Malting and Feed

In 1988, approximately 40,000 acres of barley were produced in Michigan, up from a recent low of 20,000 acres in 1978 but substantially below the all-time record of 303,000 acres in 1932. The greatest proportion (95-98 percent) is spring-planted, and much of that is intended for malting. Historically, the greatest proportion of Michigan barley has been grown for malting, but in recent years this market has declined. Fortunately, the rediscovery of barley as a high quality livestock feed has coincided with the decline in its use for malting.

For malting markets, the variety is important. It must have the basic chemical characteristics required for malting. The crop must be bright (disease free), unweathered, and practically free of other grains and foreign material. It must contain little or no broken, skinned or otherwise damaged kernels and must meet other appropriate quality standards. The official U.S. standards for various grades of six-rowed malting barley are shown in Table 1. Similar standards are available for two-rowed malting barley.

The highest quality malting barley is produced in environments where grain maturation occurs during dry, sunny weather, resulting in bright, unstained kernel development. Though such conditions can occur during July in Michigan, cloudy, overcast or rainy weather before harvest often results in staining or weathering, which decreases malting quality.

Barley is a high quality feed grain and an attractive alternative or supplement to corn with many attractive features:

1. Barley has 90 percent of the energy level of corn and a higher protein content.
2. Substantially lower labor, equipment and chemical expenditures are required for good yields.

TABLE 1

Grades and grade requirements for the subclasses six-rowed malting barley and six-rowed blue malting barley*.

Grade[1]	Minimum limits of –			Maximum limits of –					
	Test weight per bushel	Suitable malting type	Sound barley	Damaged kernels[2]	Foreign material	Other grains	Skinned and broken kernels	Thin barley	Black barley
	Pounds	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
U.S. No. 1	47.0	95.0	97.0	2.0	I.0	2.0	4.0	7.0	0.5
U.S. No. 2	45.0	95.0	94.0	3.0	2.0	3.0	6.0	10.0	1.0
U.S. No. 3	43.0	95.0	90.0	4.0	3.0	5.0	8.0	15.0	2.0

[1]Six-rowed malting barley and six-rowed blue malting barley may contain a maximum of 1.9 percent of frost damaged kernels, of which not more than 0.4 percent may be frost-damaged (major); may contain a maximum of 0.2 percent of heat-damaged kernels, of which not more than 0.1 percent may be heat-damaged kernels (major); and may contain unlimited amounts of mold-damaged kernels (minor); however, mold-damaged kernels (major) shall function as "damaged kernels" and against "sound barley."

[2]Frost-damaged kernels (minor) and mold-damaged kernels (minor) shall not be damaged kernels or scored against sound barley.

NOTE: Six-rowed barley that meets the requirements of U.S. No. 1 to U.S. No. 3, inclusive, for the subclasses six-rowed malting barley and six-rowed blue malting, shall be classified and graded according to the requirements in this section. Otherwise, it shall be graded according to the requirements in section 810.208 of the U.S. Standards for barley.

*From: U.S. Grain Standards.

3. Barley is better adapted to northern latitudes than corn, enabling excellent yields where corn is not profitable.
4. Maturity is in July, when weather conditions are favorable, rather than November or December, when most corn is harvested.
5. A July harvest can tap available labor and equipment for more efficient utilization of both time and equipment.
6. Barley is useful as a companion crop for alfalfa seedings. (It has soil pH and drainage requirements similar to those of alfalfa.)

Feed Value of Barley

Barley ranks only slightly below corn as a high energy feed grain. Like all cereal grains, including corn, it is generally deficient in vitamins A and D, minerals (phosporus and clacium) and the essential amino acids tryptophane and lysine. How-

TABLE 2
Estimated net energy and feed evaluation factors[1].

Grain	Dry matter	Crude protein	Estimated net energy/lb	ADF[2]	Corn factor	Soybean oil meal factor
Barley (dairy cows)	90	13	.86	7	0.811	0.098
Corn	90	10	.93	3	1.000	0.000
Oats (dairy cows)	90	13	.79	17	0.648	0.091
Rye	90	13	.84	3	0.749	0.096
Soybean oil meal	90	49	.84	10	0	1.00

[1]From: National Research Council. *Nutrient Requirements of Dairy Cattle,* 1978.
[2]Acid detergent fiber.

TABLE 3
Average percent composition[1].

	Mineral and Fertilizing Constituents			
Grain	Calcium	Phosphorus	Magnesium	Potassium
Barley	.05	.37	.15	.45
Corn	.03	.31	.13	.35
Oats	.08	.48	.18	.59
Rye	.07	.36	.14	.52
Soybean meal	.36	.75	.30	2.21

[1]From: National Research Council. *Nutrient Requirements of Dairy Cattle,* 1978.

ever, these deficiencies can be easily overcome by supplementing with a legume forage and a vitamin-mineral mix.

Tables 2 and 3 show the nutritional values of barley compared with those of other grains. Barley supplies considerably more energy than oats and only slightly less than corn. Its protein content, which averages about 13 percent, is similar to that of oats and higher than that of corn. Hulls compose about 15 percent of the 48 lbs/bu of good, well filled barley. Lightweight barley has a higher proportion of hulls.

For greatest palatability and animal acceptance and increased digestibility, barley should be ground or steam crimped (rolled). This also minimizes irritation caused by the rough beards that are characteristic of some varieties. Though breeding work has been done to eliminate rough beards from barley varieties, many modern, high yielding varieties still have this characteristic. Harvesting as high-moisture grain and storing in an oxygen-free silo will increase palatability because the fermentation also softens the beards.

Because of the beards, it is recommended that dry barley make up not more than 50 percent of the grain ration for dairy cattle. High-moisture barley, however, can make up 100 percent of a true grain ration.

Spring vs. Winter Barley

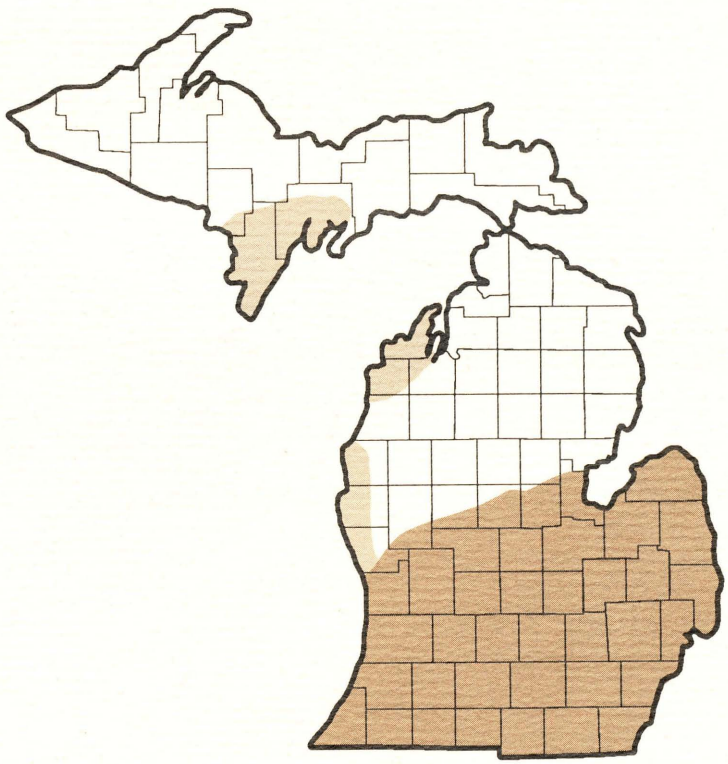
Though most barley in Michigan is the spring type, there has always been an interest in winter barley. The two types are comparable in yield potential. Winter barley begins growth early in the season, matures faster and can generally be harvested one to two weeks earlier than spring-seeded types. This increases the efficiency of labor and equipment use in both spring and summer. In years of drought stress, winter barley usually outyields spring barley. It also offers the possibility of double cropping with soybeans in some southern Michigan locations if soil moisture is adequate for a mid-summer planting.

Winter barley is not as winter hardy as wheat, so it should be planted only in southern Michigan (south of Clare-Mt. Pleasant), where chances of winter survival are best (see figure 1). Varieties differ in winter hardiness, so growers on the northern fringe of this area should select the most winter-hardy varieties.

Though no basic relationship exists between the type (spring vs. winter) of barley and its use as feed or malting, all of the current malting varieties are spring types; feed varieties are of both spring and winter types.

FIGURE 1

Areas of winter barley production in Michigan. The darker areas are those normally considered safe for winter survival. Lighter areas show where barley will survive except in years of inadequate snow cover, (4-5 out of 6 years).



CULTURAL PRACTICES FOR BARLEY

The following practices are recommended for producing maximum economic yields of high quality grain.

Land Selection

Barley responds well to high levels of soil fertility and good soil drainage. The best soils for growing barley are well drained silt or clay loams with a soil pH of 6.5 to 7.0. Light, sandy soils are poor because of low water-holding capacity. Acid soils must be limed to a pH of 6.5 to 7.0.

Variety Selection

Growers should select varieties that will meet their purposes and perform well in their area. Excellent varieties of both spring- and fall-seeded types are available, representing both feed and malting types from both public and private sources. Tables 4-6 show the characteristics and performance of a wide range of varieties in several locations in Michigan. Though they vary somewhat in characteristics and productivity, all are considered acceptable for Michigan conditions.

All varieties shown in these tables have long, fragile awns, called beards, which usually break off readily during combining. However, if the crop is harvested at higher moisture contents, some beards may adhere

TABLE 4

Performance and characteristics of spring barley varieties tested in Tuscola, Huron and Ingham counties from 1979 to 1988.

Variety	Origin	No. of tests	Test yield (bu/A)	Weight (lb/bu)	Height (inches)	Heading date	Use
Morex	Minnesota	25	80.5	49.9	35	6/13	Malting/feed
Robust	Minnesota	22	86.3	50.5	34	6/13	Malting/feed
Larker	North Dakota	21	81.7	50.2	35	6/13	Malting/feed
Bowers	Michigan	27	90.0	49.7	34	6/17	Feed
Leger	Canada	10	87.1	51.5	38	6/17	Feed

TABLE 5

1985-1986 Michigan Extension-Demonstration Variety Trials.

	Yield (bu/A)									
Location	Tuscola		Isabella		Lake City		Presque Isle		Mean	
Variety	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986
Robust	75.3	66.3	75.1	86.1	106.3	46.1	82.5	100.6	84.8	74.8
Bowers	80.3	64.2	112.6	75.9	89.2	48.1	90.0	109.4	93.0	74.4
Hazen	–	61.2	101.4	81.2	103.6	43.3	91.0	110.2	98.7	73.5
Leger	76.7	63.6	98.1	66.8	93.8	47.3	76.3	115.0	86.2	73.2
Bowman	–	63.3	–	72.1	–	24.2	–	103.4	–	65.8
Morex	76.4	58.6	88.6	54.3	–	33.3	83.6	–	82.9	48.7

to the seed and become an irritant during feeding. Though beardless barley varieties are grown in other states, they are normally lower yielding than the bearded varieties. This is also true of hull-less varieties.

Time, Rate and Method of Planting

Winter barley should be planted Sept. 10-20 and spring barley as early in the spring as the soil can be worked without causing soil compaction. Early spring planting in mid- to late April allows for pollination and seed filling before hot summer weather. Barley responds best to fertilizer when planted early. Using a grain drill, plant 2 to 2½ bushels of seed per acre in moist soil at a depth of 1 to 2 inches. When establishing a legume in a barley seeding, lower the rate to 1½ bushels per acre. Compacting soil over the rows with press wheels will result in more uniform stands.

Barley can also be drilled directly in no-till or minimum tillage situations. The key is to use proper equipment that will place the seed in the soil with good seed-soil contact. Basically, this requires a heavy drill with coulters that open the soil, leaving residue on the surface, and a press-wheel that closes the seed opening and firms the drilled furrow. Initial research at MSU has shown that such seedings, if properly done, can give yields equal to those from conventional seedings.

Winter barley may also be aerial seeded into a soybean field just before leaf drop. Under such conditions, the falling soybean leaves trap enough moisture in close contact with the seed to enable adequate stand establishment. Aerial seeding (or broadcast) on bare ground should be avoided, unless the field can be lightly tilled to provide for seed coverage.

Seed Treatment

Seed should be treated with an effective fungicide such as carboxin or Thiram to control seed-borne diseases, including seed rot, seedling blight, loose smut and other seed-borne fungi. Barley seed purchased from a certified seed grower or from other reputable seed sources will normally be treated as part of the conditioning process. If not, it should be taken to a local elevator or to a seed conditioning plant for treatment. As a last resort, drill box treatment may be used. (For additional information on seed treatment, refer to Extension bulletin E-1199, "Seed Treatment for Field Crops.")

Weed Control

A good, vigorous stand of barley will help keep most weeds under control. Chemicals such as 2,4-D or MCPA will assist in the control of broadleaved weeds. Roundup (glyphosate) is registered and labeled for control of quackgrass and other perennial weeds as a non-selective herbicide for fall application before a spring planting.

(Further information on weed

TABLE 6

Yield (bu/acre) of barley varieties tested at several locations in the Upper Peninsula (1979 to 1988).

	Alger		Menominee		Other		Average	
Variety	Yield	No. of Tests	Yield	No. of Tests	Yield	No. of Tests	Yield	No. of Tests
Morex	63	5	80	5	78	4	75	14
Bowers	65	8	80	7	77	4	73	19
Bonanza	91	2	84	3	100	1	89	6
Larker	69	4	67	3	–	–	64	7
Leger	65	5	78	3	90	3	75	11
Robust	67	4	76	3	78	3	73	10
Hazen	71	3	89	2	89	2	83	7
Birka	59	2	93	1	68	1	70	4

control is available in MSU Extension bulletin E-434, "Weed Control in Field Crops.")

Fertilization

A soil test will determine the rate of phosphorus and potassium fertilizer, as well as any minor elements needed for barley. It is more difficult to test for the amount of available nitrate in the soil, so nitrogen recommendations are based on research with various nitrogen rates. Sixty to 80 pounds of actual nitrogen per acre are recommended for barley, along with the levels of P and K prescribed by the soil test results. The actual amount of nitrogen recommended will vary, depending on the yield goal at a particular location and management level, and whether the barley was preceded by a plowed-down legume or manure application. Table 7, from MSU Extension bulletin E-550, "Fertilizer Recommendations for Field Crops," shows the MSU nitrogen recommendations for barley.

Application of higher nitrogen rates may not be desirable for malting barley because this can result in higher protein contents (Table 8), which may not be acceptable for malting.

Phosphate and potash are most efficiently used when banded 1 inch below the seed. Banded fertilizer will help develop a vigorous plant even when soils are cold in the spring.

If a legume is to be seeded, fertilizer rates — particularly phosphorus and potassium — must satisfy the needs of the legume as well as the barley.

TABLE 7

Nitrogen fertilizer recommendations (lb/A) for barley[1].

Yield goal (bu/A)	Nitrogen recommendation
40	30
50	40
60	50
70	60
80	70
90	80
100	90
110	100
120	–
130	–
140	–
150	–

[1]From *Fertilizer Recommendations: Vegetable, Field Crops in Michigan,* Extension bulletin E-550.

Recommendations are calculated from the following formula and rounded to the nearest 10 pounds:

$XN = A + B \times YG$

Where: XN = lb N/acre
YG = yield goal, bu/acre
for oats A = 0 and B = .4
for barley A = −12 and B = .8
for wheat A = −13 and B = 1.33

TABLE 8

Nutritional quality of Bowers barley grown under various nitrogen management regimes in Presque Isle County, 1985.

	Management Plots			
Nitrogen regime (lb/A)	Moisture content (%)	Dry matter (%)	Crude protein (%)	Crude protein, D.M. basis (%)
50	7.9	92.1	9.8	10.6
50-50C[1]	7.9	92.1	10.7	11.7
50-50[2]	7.9	92.2	10.1	11.0
50-50-10C[3]	7.8	92.2	11.1	12.0
50-100	7.8	92.2	13.3	14.4

[1]⅓ lb/acre Cerone applied at growth stage 8.

[2]Second increment of nitrogen applied at growth stage 6.

[3]Third increment of nitrogen applied at growth stage 10.

Disease Control

Several diseases of varying importance occur on cultivated barley in Michigan. These include net blotch (*Helminthosporium teres*), spot blotch (*H. sativum*), stripe (*H. gramineum*), scald (*Rhynchosporium secalis*), loose smut (*Ustilago nuda*) and barley yellow dwarf virus (BYDV). The leaf pathogens of the *Helminthosporium* species may also be carried on the seed and often cause seed damage and seedling blight. Disease symptoms range from distinct brown to black spots or yellow to brown stripes on the leaves, in the case of *Helminthosporium*, to replacement of the grain by masses of black spores, in the case of smuts. Cool, wet or humid weather conditions in the spring favor disease development.

Barley Yellow Dwarf Virus affects barley leaves by causing them to turn bright yellow. Symptoms begin at the leaf tip and advance towards the base, resembling those of nitrogen deficiency. Infected plants are stunted and produce little or no seed. BYDV is favored by moderate temperatures. This virus is transmitted by aphids only. The Green Bug, Corn Leaf, English Grain and Oat Bird-Cherry are the most common. All cereal crops, lawn and pasture grasses are host for BYDV.

Cultural practices offer a means of reducing disease problems. Rotate crops whenever possible, avoid planting into barley stubble, plant spring barley as early as possible, and use high quality, treated, certified seed. Select disease-resistant varieties if their agronomic characteristics are acceptable and if the potential for disease problems is high.

Foliar diseases in spring barley rarely occur at damaging levels when good cultural practices are followed, and fungicide applications are rarely effective in increasing barley yields.

Plant Growth Regulators (PGR)

In some years, lodging may substantially reduce barley yields, especially under the high nitrogen rates sometimes used in intensive cereal management or in fields where manure has been added. Early lodging results in poor grain fill and often leads to increased disease problems. Lodging late in the growing season hinders harvesting operations and can lower grain quality. The timely use of

TABLE 9

1986 Michigan Extension-demonstration barley management trials.

Seeding rate (bu/A)	Nitrogen rate (lb/A)	Cerone	Yield (bu/A) Tuscola County	Isabella County	Presque Isle County	Menominee County	Statewide mean
1.5	0	no	–	52.5	46.0	–	49.3
2.5	0	no	–	62.1	50.0	–	56.1
1.5	60	no	77.4	66.6	74.3	88.5	76.7
2.5	60	no	84.9	69.7	77.0	97.0	82.1
1.5	60+40	no	63.0	75.4	72.5	93.3	76.0
2.5	60+40	no	87.6	72.0	86.3	111.5	89.4
1.5	60+40	yes	81.3	73.2	96.5	98.5	87.4
2.5	60+40	yes	81.9	79.3	83.3	107.5	88.0
1.5	100	no	79.0	79.5	79.8	95.3	86.4
2.5	100	no	83.5	68.2	74.8	108.3	83.7
1.5	100	yes	84.7	79.8	88.3	91.5	84.8
2.5	100	yes	83.9	82.6	78.0	109.8	88.6

a plant growth regulator (PGR) can shorten and strengthen the stem of the barley plant and increase its lodging resistance. The most common PGR in the United States is ethephon, marketed under the trade name "Cerone." Cerone is registered for use on barley in Michigan. The recommended time for Cerone application is when the flag leaf is appearing (Feeke's growth stages 7, 8 and 9) and just before heading (see Fig. 2).

Harvesting and Storage

Barley is ready to harvest at about 13 or 14 percent moisture and is safe to store at this moisture without risk of heating. When ripe, the heads of most barley varieties will nod over and are susceptible to breaking off, causing yield losses. Lodging is another potential problem. Delayed harvest may cause heavy quality and yield losses.

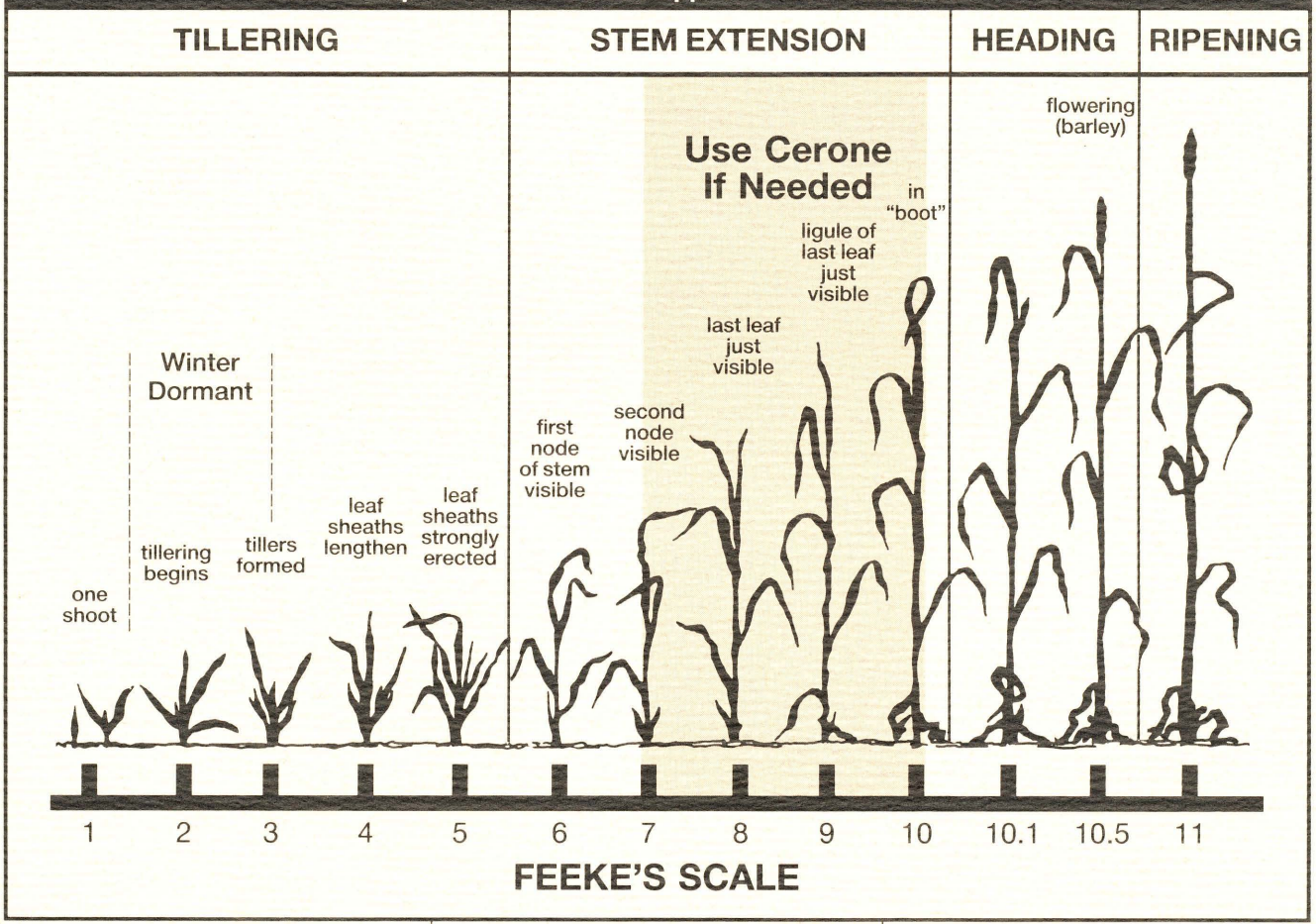
In storage, damp barley may heat and become moldy. Storing in an aerated bin will prevent this. In extreme cases, artificial drying may be required.

High-moisture Barley

Harvesting barley at 25 to 32 percent moisture is another method that has gained popularity in Michigan in recent years. The crop is harvested with a conventional combine and then ensiled in an airtight, upright silo or treated with an acid preservative. This method offers many advantages, including the reduction of field losses because of the earlier harvesting. It is very important to harvest grain in a timely manner for high-moisture preservation because the moisture content of barley drops

FIGURE 2

Barley growth stages according to Feeke's Scale. Proper time for Cerone application is indicated.



rapidly once it has reached 32 to 35 percent during the maturing process in the field.

Advantages of harvesting high-moisture barley:

1. Reduces field loss.
2. Increases palatability to animals.
3. Softens beards, which can irritate feeding animals.
4. Combining can be done 24 hours per day.
5. Small showers do not stop combining.
6. Barley can substitute for 100 percent of corn in dairy cattle rations.

Disadvantages:

1. Timing of harvest is more critical than for dry barley because kernel moisture changes rapidly.
2. High-moisture barley needs to be stored in oxygen-free silos or be acid treated.
3. It must be fed to livestock — it can not be sold as a "dry" grain.

Intensive Cereal Management (ICM)

Recently interest has grown in applying intensive cereal management (ICM) practices to barley in Michigan. This concept has been practiced in Europe and in some areas of North America to maximize economic yield per acre. ICM practices differ from conventional management practices only in that they are used as a total management program, rather than as individual practices. ICM techniques usually involve timely use of chemicals to supply plant nutrients, plant growth regulators and pesticides (especially fungicides) to control diseases and insects. Timely application is based on stage of plant growth rather than calendar dates. One system developed to help growers identify these growth stages is Feeke's scale, which numbers growth stages from 1 to 11 (Fig. 2).

ICM is a high-management, high-investment production system that is not appropriate for all growers. Where ICM practices are used, three concepts are important to their success. First, maximum economic yields are reached when all appropriate practices are incorporated into a complete management program. Second, ICM inputs must be made in a timely way to be successful. This demands careful attention to plant growth stages and a good understanding of plant growth in general. Third, precision and accuracy of application of all inputs are essential. In the European ICM systems, precision of application inputs such as fertilizers, growth regulators and fungicides is attained by use of "tram-lines". These are standardized, uniform wheel tracks in a pattern across the field that help guide ground application equipment in all trips across the field so that it applies all inputs with the greatest precision. Where tram-lines are used, they have wide support as perhaps the key concept in the entire ICM approach.

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